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## SCIENCE &amp; TECHNOLOGY

## CHINA

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## STRUCTURE OF LONG MARCH-3 ROCKET DETAILED

Beijing HANGTIAN [SPACEFLIGHT] in Chinese No 3, 26 May 87 p 1, inside front cover

[Article by Huo Ming [3499 2494]]

[Text] The Long March-3 is a three-stage liquid propellant rocket 43.25 meters in length. The first and second stages have a diameter of 3.35 meters and the third stage has a diameter of 2.24 meters. The maximum diameter of the satellite cowling is 2.60 meters, and the tail fins have a span of 6.15 meters.

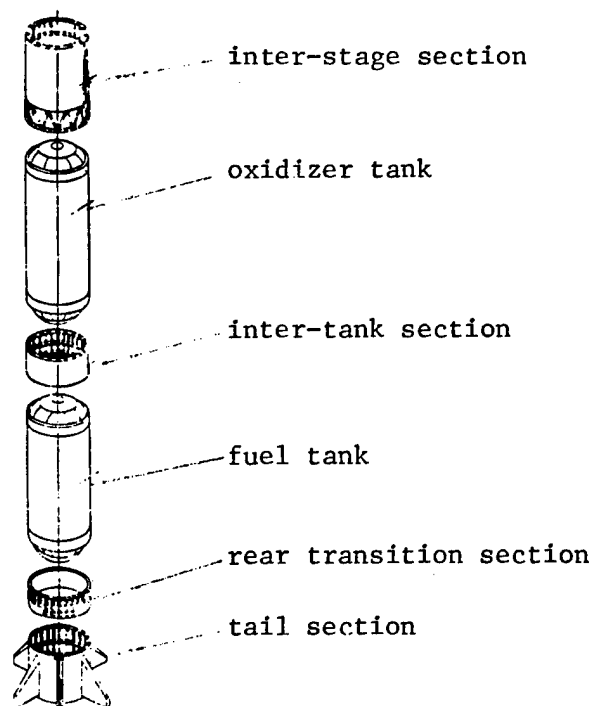
The rocket structure's main function is to connect the power plant, the control system, the telemetry system and the tracking/sensing system into an integral unit and to carry all the internal loads; in addition, the cylindrical shell of the rocket carries various external loads and protects the internal systems from aerodynamic abrasion and heating. The main section of the rocket is a large container for fuel storage. The rocket structure is the structure for all the systems of the rocket.

In the first two stages of the Long March-3, the oxidizer tank with higher specific gravity is located in the forward section and the fuel tank with lower specific gravity is located in the rear in order to move the center of gravity forward to achieve attitude stability. In the third stage, the long fuel tank with higher specific gravity is located in the front, and the short oxidizer tank is located in the rear. When the rocket is in its vertical position on the launch pad, the hydrogen gas from the fuel tank is directly ejected into the air, and by-passes the oxidizer tank for improved safety. This configuration also reduces the length of the fuel lines to the forward tank, thus minimizes the heat transfer through the lines and ensures that the temperature level can be maintained to meet the specified requirement.

First Stage. It consists of the inter-stage section, the oxidizer tank, the inter-tank section, the fuel tank, the rear transition section, the tail section and the tail fins (see Figure 1).

The inter-stage section is the connecting and load-carrying section between stage 1 and stage 2. It also serves as the housing for the second-stage engine, and is divided into two parts: the shell section and the pole section. The function of the pole section is to facilitate ignition and flame dispersion of the upper stage engine during separation.

Figure 1



The oxidizer tank and the fuel tank are both load-carrying storage tanks; they are equipped with anti-sway plates, pressure overflow tubes and anti-eddy devices.

The load-carrying section between the two tanks is called the inter-tank section. It has five windows along the circumference to provide access for assembly and inspection.

The rear transition section is located behind the fuel tank and in front of the tail section. It is designed to provide diffusion of the concentrated load.

The entire tail section is composed of two half sections joined together along the longitudinal direction; it has four engine inspection windows. In order to improve flight stability, four tail fins are installed at the end of the tail section. The base of the tail section is equipped with heat-protection plates and skirts to prevent reverse flow of engine flames. The tail section not only carries the load while the rocket is in its vertical position, but also serves as the gousing for the first-stage engine.

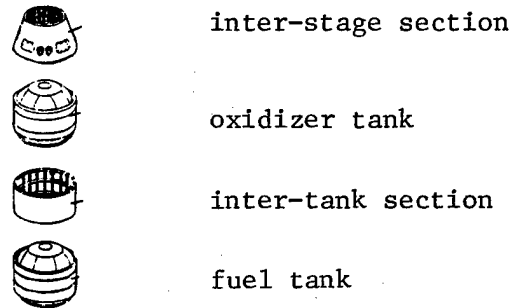
Second Stage. It also consists of an inter-stage section, an oxidizer tank, an inter-tank section and a fuel tank (see Figure 2).

The inter-stage section is the connecting and load-carrying section between the second stage and third stage; it also serves as the housing for the third-stage engine. This section has a cone-shaped design with an upper

diameter of 2.25 meters and a lower diameter of 3.35 meters. In the middle of this section, four windows uniformly distributed along the circumference are provided for engine inspection and test.

Except for the volume of the tanks, the oxidizer tank, the fuel tank and the inter-tank section have the same structure as the first stage.

Figure 2



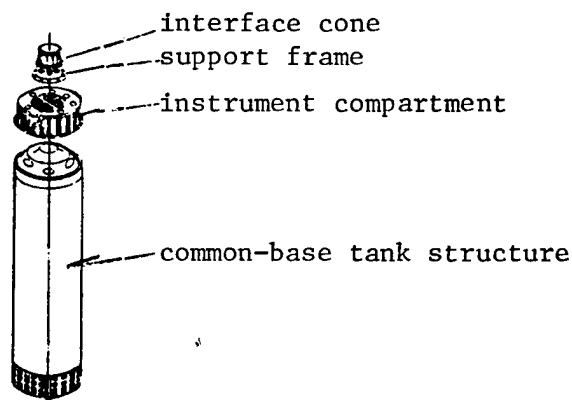
Third Stage. It consists of the satellite support frame, the instrument compartment and the tank structure (see Figure 3).

The support frame is a load-carrying structure for supporting the satellite; it is divided into two parts: the interface cone and the support frame. The entire frame has a cone-shaped design; the upper portion is connected to the base of the satellite, and the lower to the instrument compartment.

The instrument compartment is a section for housing the instruments and equipment, and is located above the third-stage tank inside the satellite cowling. It is also a load-carrying section for supporting the satellite. It consists of the cone-shaped shell body, the annular disk and support frame, and the crossbeam. The structural design of the instrument compartment is new and practical.

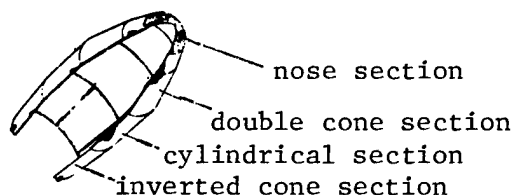
The third-stage tank structure is a common-base type storage tank; the forward tank is the fuel tank and the rear tank is the oxidizer tank, the common base has a convex surface facing the forward tank. It consists of the following sections: the short shell structures in the front and rear, the forward base, the common base, the rear base and the tank cylinder. Since the third-stage engine uses low-boiling-point liquid hydrogen ( $-253^{\circ}\text{C}$ ) and liquid oxygen ( $-183^{\circ}\text{C}$ ) as propellant, the tank structure is covered with a layer of insulation to minimize heat transfer. Also, to prevent heat transfer between the liquid oxygen and liquid hydrogen tanks, the two tanks are separated by vacuum.

Figure 3



Satellite Cowling. The cowling is in the form of an oyster shell which can be split into two halves symmetric with respect to the plane containing the center line; it is assembled onto the rocket body on the launch pad. Its main function is to protect the satellite from atmospheric abrasion and aerodynamic heating during flight; upon exiting the atmosphere, it is automatically unlocked and discarded. The cowling is composed of the nose section, the double cone section, the cylindrical section and the inverted cone section (see Figure 4).

Figure 4



The rocket also has auxiliary parts such as tubing and valves. There is a wide variety of tubing including liquid-transport tubing, gas-transport tubing, high-pressure tubing ( $\sim 230$  atmospheres), normal-pressure tubing, low-temperature tubing ( $\sim -253^\circ\text{C}$ ), normal-temperature tubing, hard tubing, soft tubing, single-layer tubing, and double-layer tubing.

The valves including filling valves, cleaning and scavenging valves, overflow valves, safety valves and exhaust valves. They can be aerodynamically controlled, electrically controlled, or manually controlled. In terms of functions, there are low-temperature valves, normal-temperature valves, high-pressure valves, medium-temperature valves, and low-temperature valves; in terms of construction, there are ball valves, gate valves, end-sealed valves and side-sealed valves.

The rocket structure of the Long March-3 not only inherits many of the unique features of previous Chinese rocket designs but also takes advantage of many new technologies; its design is considered to have reached the advanced standards of other countries.

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CSO: 4008/81

## OPTICAL PROBE DIAGNOSIS IN LASER-PRODUCED PLASMA

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 14 No 4,  
20 Apr 87 pp 247-248

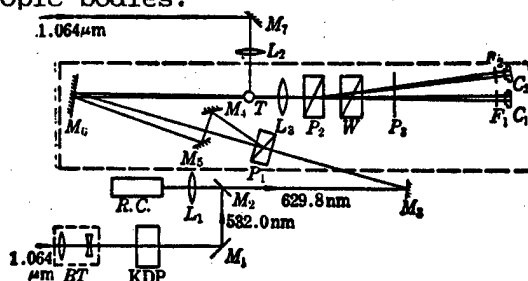
[Article by Weng Zhiming [3076 2494], Meng Shaoxian [1322 4801 6343], Xu Zhizhan [1776 5267 1455], Zhang Weiqing [1758 0251 3237], and Lin Lihuang [2651 4409 3552], of the Shanghai Institute of Optics and Fine Mechanics]

[Text] This paper reports on the Raman-shifted visible probe system recently set up in the six beam Nd: glass laser facility in the Shanghai Institute of Optics and Fine Mechanics and its preliminary diagnostic results in laser-produced plasma experiments.

Plasma optical probe diagnostics is based on propagation of light in plasma being like a sort of propagation in a medium where the index of refraction is continuously changing. The medium's index of refraction is  $n = (1 - N_e/N_c)^{1/2}$ , in which  $N_e$  is the electron density,  $N_c$  is the boundary density at that particular wavelength,  $N_e = 1.2 \times 10^{21} \lambda^{-2} (\text{cm})^{-3}$ , and  $\lambda$  is in units of  $\mu\text{m}$ . Consequently interference methods can be used to measure conditions of optical path variation after the light traverses the plasma. Under conditions where the plasma density is assumed to be a symmetric column, Abelian transforms can be used to process the optical path difference data, obtaining an outline of the electron density.

Optical probes used in lasing plasmas require a sufficiently narrow pulse width, good synchronization with the primary pulse, a suitable wavelength, and the ability to avoid plasma harmonic interference. For these reasons we adopted backward stimulated Raman scattering with better directionality and pulse width compression to produce a visible probe optical beam.

In order to obtain changing information on the electron density in the process of the plasma's rapid expansion, we utilized (Luoxiong) polarized prism to improve a Nomarski interferometer (1) for plasma interference images for different points in time in each illumination of the target. this sort of interferometer is capable of being broadly used in ultra rapid process diagnosis of microscopic bodies.



BT-telescope;  $C_1, C_2$  - camera cassettes;  $F_1, F_2$  - 630nm narrow band optical filters;  $L_1, L_2, L_3$  - converging lens;  $M_1, M_2$  - 532nm narrow band totally reflective mirrors;  $M_3 \sim M_6$  - aluminum totally reflective mirrors;  $P_1, P_2$  - (Luoxiong) prisms;  $P_3$  - polarized plate; R.C. - Raman box; T - target; W - (Wolasidun) prism.

The experimental light path was as shown in Fig. 1. The system uses a several stage amplifier of one beam of a six beam lasing target apparatus as the light source to produce the probe light. Since it originates from a laser pulse of a heated plasma with the same Nd:YAG oscillator, the problem of synchronization is well resolved. The 45mm 1.064  $\mu\text{m}$  laser beam enters the KDP crystal frequency multiplier through the telescope BT. After reflection from the 532 nm narrow band totally reflective mirrors  $M_1, M_2$ , the frequency multiplied light enters the Ramon box, producing 629.8nm backward stimulated Raman light with energies reaching over 200  $\mu\text{J}$ . The Raman light pulse, measured using a visible fringe phase meter, at narrowest attained 40ps. At the time the Corresponding 1.064  $\mu\text{m}$  primary laser target pulse width was 250ps, sufficient to meet the requirements of plasma diagnosis.

The amplitude component interference system was as shown inside the dashed lines of Fig. 1. The key to this system is the use of two luoxiong prisms. After a single non-polarized beam enters the  $P_1$  luoxiong prism, it is divided into two beams polarized at right angles to each other and basically the same magnitude. After one beam goes through an adjustable optical delays (with a shortest possible delay of 260ps) composed of  $M_4$  and  $M_5$ , the two beams run basically parallel to reach the target. After passing through the imaging lens  $L_3$  (f/2.5), the second luoxiong prism  $P_2$  separates the two beams according to their direction of polarization. The Wolasidun prism W, right after this, together with  $P_1$  and the analyzer  $P_3$  form a Nomarski interferometer. (1)

The primary laser used to produce and heat the plasma is perpendicular to the direction of the probe light. We have carried out diagnostic measurements on laser irradiation of spherical, cylindrical, and plane targets. The primary laser energy was a few Joules, the pulse width 250ps, laser spot diameter about 80  $\mu\text{m}$ , and the power density on the target was  $(1 \sim 5) \times 10^{14} \text{ W.cm}^{-2}$ .

Figures 2(a) and 2 (b) are two interference photographs taken at different times of laser irradiated sphere. They had delays times of 500ps and 760ps from the primary pulse and the spherical shell diameter was 81.5 $\mu\text{m}$ . The reference measure on the scale is 100 $\mu\text{m}$ . From these photographs, the interference fringes and their change over time can be seen clearly. The smooth interference fringes in the direction of the laser in Fig. 2(a) demonstrate the electron density indentation caused by the laser light compression; the arc shaped fringes of Fig. 2(b) indicate that these indentations have gradually disappeared in about 760ps. After assuming that the plasma distribution depends on the heated laser axial symmetry and using Abelian transforms to process the above photographs, we obtained a density distribution at a point 160 $\mu\text{m}$  from the target center as shown in Fig. 3. The figure clearly shows the form and disappearance of this sort of indentation.



(a)



(b)

Fig. 2

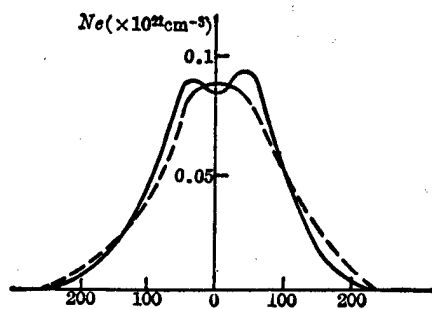


Fig. 3

Solid line:  $\Delta t = 500$  ps

Dashed line:  $\Delta t = 760$  ps

The authors are grateful for the assistance and facilitation provided by the Institute's Six Beam Laser Apparatus Operations Group.

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12966/12232

CSO: 4008/80

## FREE ELECTRON LASER IN THE VISIBLE OR UV REGION

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 7, No 4, Apr 87  
pp 317-323

[Article by Fu Ensheng [0265 1869 3932], Ling Genshen [0407 2704 3234], and Wang Zhijiang [3769 0037 3068] of the Chinese Academy of Sciences, Shanghai Institute of Optics and Fine Mechanics, Received 17 Feb 1986. Revised manuscript received 24 Aug 1986]

[Abstract: Madey pointed out that the use of a linear accelerator to limit the beam flow density of an electron beam allows free electron lasers to attain a shortwave limit of about  $1\mu\text{m}$ . This paper proposes using ultraharmonic operation with a free electron laser. Then using a linear accelerator we can expect to obtain visible and ultraviolet shortwave lasing. The key to realizing free electron laser ultraharmonic operation is establishing a high K value Wiggler magnetic field.]

## [Text] I. Introduction

Free electron lasers are a hot topic in the field of lasers in the eighties. (1)  
Presently investigators are concerned with the problem of expanding free electron lasers toward the short wavelengths. Madey has pointed out that free electron lasers using a linear accelerator are able to reach a short-wave limit of about  $1\mu\text{m}$ . (2)

This paper theoretically analyzes the gain properties of the spontaneous radiation spectrum and ultraharmonics of relativistic electrons passing through a Wiggler magnetic field, and discusses the conditions of free electron laser ultraharmonic operation, as well as the possibility of obtaining a visible and ultraviolet waveband free electron lasing using ultraharmonics.

## II. Electron Equations of Motion

Let the field strength of a linearly polarized magnetic field oriented in the y direction be

$$B_x = B_0 \sin k_0 z e_y, \quad (1)$$

in which  $B_0$  is the amplitude of the magnetic field, the wave number,  $k_0 = (2\pi/\lambda_w)$ , and  $\lambda_w$  is the period length of the magnetic field. The electric



field vector and the magnetic field vector of a linearly polarized lasing field can be represented as

$$\left. \begin{aligned} \mathbf{E} &= E_0 \cos \psi_0 \mathbf{e}_z, & \mathbf{B} &= B_0 \cos \psi_0 \mathbf{e}_y, \\ \psi_0 &= f k_0 z - f \omega_0 t + \phi, \end{aligned} \right\} \quad (2)$$

in which  $\psi_0$  is the optical field phase,  $f$  is the harmonic order,  $k_0 = (2 / \lambda_0)$  is the lasing wavelength,  $\omega_0 = c k_0$  is the angular frequency of the lasing field,  $c$  is the speed of light, and  $\phi$  is the initial phase.

The motion of electrons in the field is determined by the Lorentz equation

$$\frac{d(m\gamma\mathbf{v})}{dt} = -e \left( \mathbf{E} + \frac{\mathbf{v}}{c} \times \mathbf{B} \right), \quad (3)$$

in which  $\mathbf{B} = \mathbf{B}_w + \mathbf{B}_s$ . Substituting (1) and (2) into (3) we get

$$\left. \begin{aligned} \frac{dv_x}{dt} &= -\frac{e}{m\gamma} \left( E_0 \cos \psi_0 - B_0 \frac{v_x}{c} \sin k_0 z \right), \\ \frac{dv_y}{dt} &= 0, \\ \frac{dv_z}{dt} &= -\frac{e}{m\gamma c} B_0 v_x \sin k_0 z, \end{aligned} \right\} \quad (4)$$

in which we assume  $\gamma$  is a constant and ignore the influence of  $\mathbf{B}_s$ . Since  $v_y = 0$ , we get velocity components for the electrons

$$\left. \begin{aligned} v_x &= -\frac{cK}{\gamma} \cos k_0 z, \\ v_z &= v_{0z} - \frac{cK^2}{4\gamma^2} \cos 2k_0 z, \end{aligned} \right\} \quad (5)$$

in which  $K = (eB_0 / (mc^2 k_0))$  is the deviation coefficient, an important parameter in Wiggler magnetic fields. From integration of formula (5) we get the coordinate function of the electrons

$$z(t) = v_{0z} t - \frac{K^2}{8\gamma^2 k_0} \sin 2k_0 z, \quad (6)$$

It is just such a minute vibration of the electrons in the  $z$  direction which causes harmonic production of free electron lasers. <sup>(3)</sup>

### III. Spontaneous Radiation Spectrum of the Electrons

Since this paper is discussing Compton scattering type free electron lasers, we ignore the interaction between electrons and can use the single electron model to describe the physical processes. The energy of radiation(2) of a single electron in a unit solid angle unit frequency interval is: [Note: The direction of observation is parallel to the axial direction  $z$ .]

$$\frac{dW}{d\Omega d(f\omega_s)} = \frac{e^2 f^2 \omega_s^2}{4\pi^2 c} |Q|^2, \quad (7)$$

$$Q = \int_0^L \beta_{\perp}(z) \exp\left\{i \frac{f\omega_s}{c} \int_0^z [1 - \beta_{\parallel}(z')] dz'\right\} dz. \quad (8)$$

in which  $\beta_{\perp} = (v_{\perp}/c)$ ,  $\beta_{\parallel} = (v_{\parallel}/c)$ , and  $Q$  is called the complex amplitude. Through involved computations to get the complex amplitude value,  $Q$ , and substituting formula (9) into formula (7), we get the spontaneous radiation energy of a single electron within a unit frequency interval in a unit solid angle

$$|Q|^2 = \frac{N^2 K^2 \lambda_w^2}{4\gamma} [J_{(f-1)/2}(f\xi) - J_{(f+1)/2}(f\xi)]^2 \left[ \frac{\sin 2\pi N f \delta}{2\pi N f \delta} \right]^2, \quad (9)$$

$$\frac{dW}{d\Omega d(f\omega_s)} = \frac{e^2 f^2 \omega_s^2 N^2 \lambda_w^2}{16\pi^2 c \gamma^2} F(f, K) \left[ \frac{\sin 2\pi N f \delta}{2\pi N f \delta} \right]^2, \quad (10)$$

$$F(f, K) = K^2 [J_{(f-1)/2}(f\xi) - J_{(f+1)/2}(f\xi)]^2, \quad (11)$$

in which  $F(f, K)$  is defined as the coupling coefficient of the electron and the radiation field. Evidently, the spontaneous radiation energy of a single electron in a unit solid angle unit frequency interval is directly proportional to  $F(f, K)$  and for a fixed harmonic order  $f$ ,  $F(f, K)$  is only related to the deviation coefficient  $K$  of the Wiggler magnetic field. The relationship of  $F(f, K)$  and the value of  $K$  is shown in Figure 1. When  $K \ll 1$ ,  $F(f, K)$  is very small so the harmonic wave radiation is very weak. When  $K \gg 1$ ,  $F(f, K)$  rapidly increases indicating that by proper selection of  $K$ , stronger harmonic radiation can be achieved.

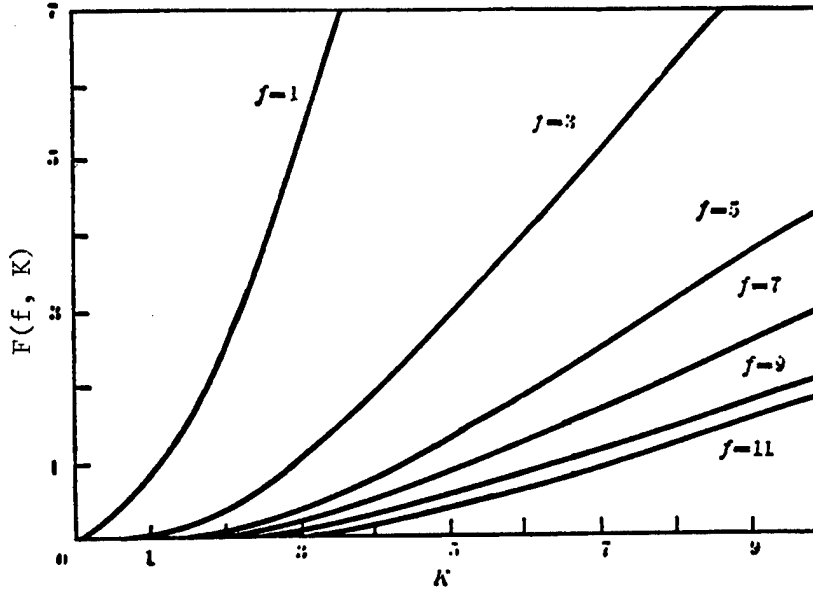


Figure 1. Coupling coefficient between electron and optical field  $F(f, K)$  versus  $K$  value

#### IV. Gain in Free Electron Lasers

Assuming that the energy of the electron's speed loss is entirely converted into radiation, then, from the definition of gain, we have

$$G = \frac{n_e (mc^2 \gamma) c}{(cE_0^2/4\pi)} \langle \delta \rangle, \quad (12)$$

and according to the Madey Theorem<sup>(5)</sup>

$$\langle \delta \rangle = \frac{1}{2\gamma} \frac{\partial}{\partial \gamma} \langle (\Delta \gamma)^2 \rangle = -\frac{k_z^2 a_z^2}{2\gamma} \frac{\partial}{\partial \gamma} |Q|^2. \quad (13)$$

Therefore

$$G = -\frac{4\pi n_e e^2}{2mc^2} \frac{\partial}{\partial \gamma} |Q|^2. \quad (14)$$

Substituting formula (9) into (14) gives

$$G = \frac{\pi f \omega_p^2 N^3 \lambda_w^2}{c^2 \gamma^3} F(f, K) \frac{2 - 2 \cos x - x \sin x}{x^3}, \quad (15)$$

in which  $x = 4\pi N f \lambda_w \gamma$ . When  $x = 2.6$ , the maximum value of gain is obtained

$$\left. \begin{aligned} G_{\max}(f, K) &= 0.424 \frac{f \omega_p^2 N^3 \lambda_w^2}{c^2 \gamma^3} F(f, K), \\ \omega_p^2 &= \frac{4\pi n_e e^2}{m}, \end{aligned} \right\} \quad (16)$$

in which  $\omega_p$  is the plasma frequency,  $n_e$  is the electron density,  $m$  is the mass of an electron,  $e$  is the electron charge,  $N$  is the period number of the Wiggler magnetic field,  $N = (L/\lambda_w)$ , and  $L$  is the length of the Wiggler magnetic field.

The gain of each order harmonic is directly proportional to the harmonic order,  $f$ , and to the coupling coefficient  $F(f, K)$ . Figure 2 represents the variation of the ratio of harmonic gain to fundamental gain versus the value of  $K$ . From this we know that when  $K < 3$ , the normalized harmonic gain is in direct proportion to the value of  $K$ . When  $K > 4$ , the harmonic gain reaches saturation. The higher the harmonic order the higher the value of  $K$  necessary for saturation to be reached. When  $K = 3$ , the gain of the third order harmonic reaches 60 percent of the fundamental.

For conditions near resonance

$$\gamma^2 \simeq \frac{\lambda_w}{2\lambda_s} [1 + (1/2) K^2], \quad (17)$$

Substituting formula (17) into formula (16) gives

$$G_{\max}(f, K) = 1.199 \frac{f \omega_p^2 N^3 \lambda_w^{1/2} \lambda_s^{3/2}}{c^2 [1 + (1/2) K^2]^{3/2}} F(f, K) \quad (18)$$

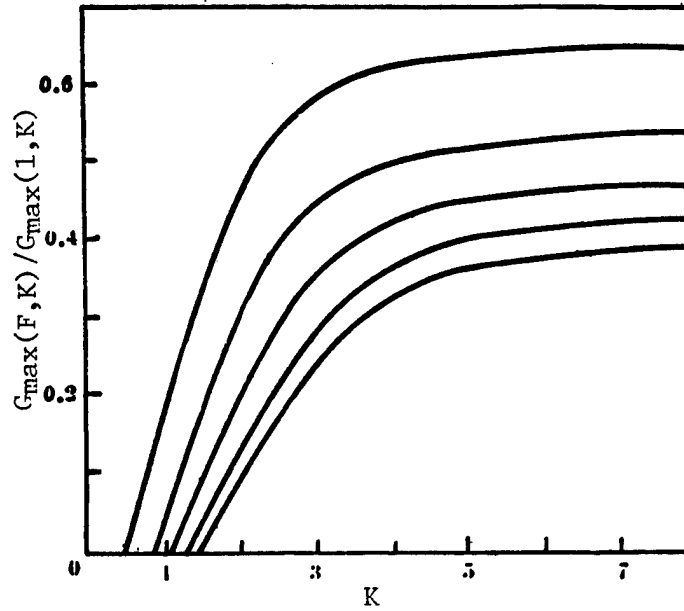


Figure 2. The Normalized gain  $G_{\max}(f, K)/G_{\max}(1, K)$  versus  $K$  value

From formula (18) it is clear that the gain of shortwave lasing ( $\lambda_s$  small) is low. Figure 3 is the relationship of the gain  $G_{\max}(f, K)/w_p^2 N^3$  to harmonic order  $f$ , for different lasing wavelengths,  $\lambda_s$ . In order to raise shortwave laser gain,  $w_p^2$  can be increased. However it is restricted by the Lawson-Penner criterion.<sup>(6)</sup> The Lawson-Penner criterion points out that the peak value current  $i_p$  of a linear accelerator satisfies

$$i_p = 10^4 \gamma^2 s^2,$$

in which the units of  $i_p$  are amperes,  $s^2$  is the product of electron beam emission in the  $x$  and  $y$  directions in units of  $\text{cm}^2 \text{rad}^2$ . Consequently, the  $w_p^2$  determined from formula (18) is  $6.6 \times 10^{21} \text{sec}^{-2}$  and if using  $0.53 \mu\text{m}$  as a fundamental (corresponding to  $\gamma = 534$ ), when  $N = 50$ , the gain  $G_{\max}(5300\text{\AA}) = 39$  percent. Using  $1.06 \mu\text{m}$  as fundamental and keeping  $N = 50$ , its fundamental gain  $G_{\max}(1.06 \mu\text{m}) = 115$  percent and its third order harmonic ( $3500\text{\AA}$ ) gain is 66 percent. For this reason, using a longer fundamental to serve as electron beam bunching, its harmonic gain will usually be higher than the gain using a short wave as fundamental.

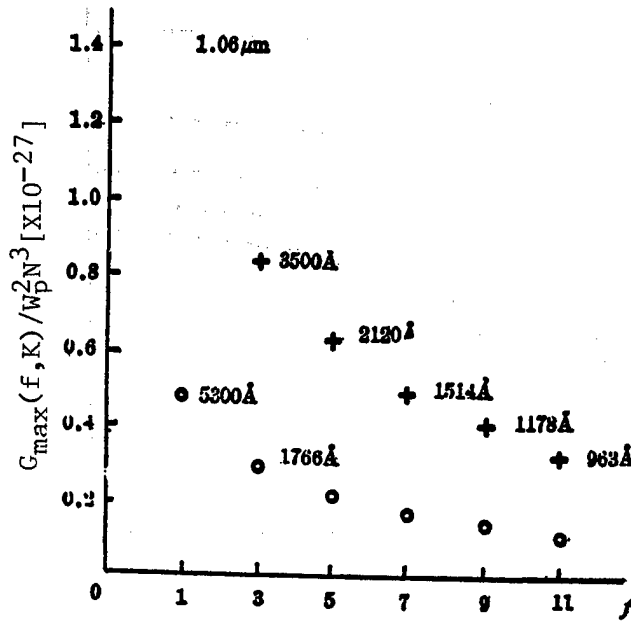


Figure 3. Gain  $G_{\max}(f, K)/W_p N^3$  versus harmonic order  $f$  when  $k = 3$  at different lasing wavelengths

We noted above that  $x = 2.6$  when the extreme value of gain is obtained. The corresponding incident laser power required is

$$\left. \begin{aligned} I_s &= \frac{1}{2z_0} \left( \frac{mc^2}{e} \right)^2 (a_s k_s)^2, \\ a_s k_s &= \frac{k_0 (\Delta\gamma)^2}{K \{ \cos \psi_r - [(\pi/2) - \psi_r] \sin \psi_r \}}, \quad \Delta\gamma = \gamma\delta, \end{aligned} \right\} \quad (19)$$

in which  $z_0$  is the vacuum impedance with a value of  $377 \Omega$ . Figures 4 and 5 show the initial laser power required to attain maximum gain.

## V. Conclusion

According to the above analysis, if we want to use a linear accelerator (energy range of 30 ~ 200 MeV) to achieve visible and ultraviolet waveband free electron lasing, then the following course must be adopted:

1. Use ultraharmonic output of a free electron laser so as to break the  $1 \mu\text{m}$  shortwave limit;
2. In order to obtain harmonic output with high gain, a Wiggler magnetic field deviation coefficient  $K > 3$  must be selected;
3. Use  $1.06 \mu\text{m}$  as the fundamental wave. With present laser technology, sufficient strength lasing power can be obtained at  $10.6 \mu\text{m}$ ,  $1.06 \mu\text{m}$ , and  $0.53 \mu\text{m}$ . However, with  $10.6 \mu\text{m}$  as fundamental, even using the 11th harmonic will reach into a visible region. If  $0.53 \mu\text{m}$  is used as the fundamental, the electron beam energy required exceeds the energy range of the usual linear accelerator. Even if a high energy linear accelerator can be employed, the

gain of the fundamental itself is only 39 percent and the harmonic gain will be even lower. Using  $10.6\mu\text{m}$  as the fundamental the third harmonic ( $3500\text{\AA}$ ) and the fifth harmonic ( $2120\text{\AA}$ ) both have rather high gains ( $G_{\text{max}}(3500\text{\AA}) = 66$  percent and  $G_{\text{max}}(2120\text{\AA}) = 50$  percent). Consequently, using  $1.06\mu\text{m}$  as the fundamental it is possible to obtain free electron laser harmonic output in the visible and ultraviolet band.

Of course, obtaining free electron lasing at shortwaves is certainly not limited to use of a linear accelerator. More appropriate is the use of a high energy electron storage ring.

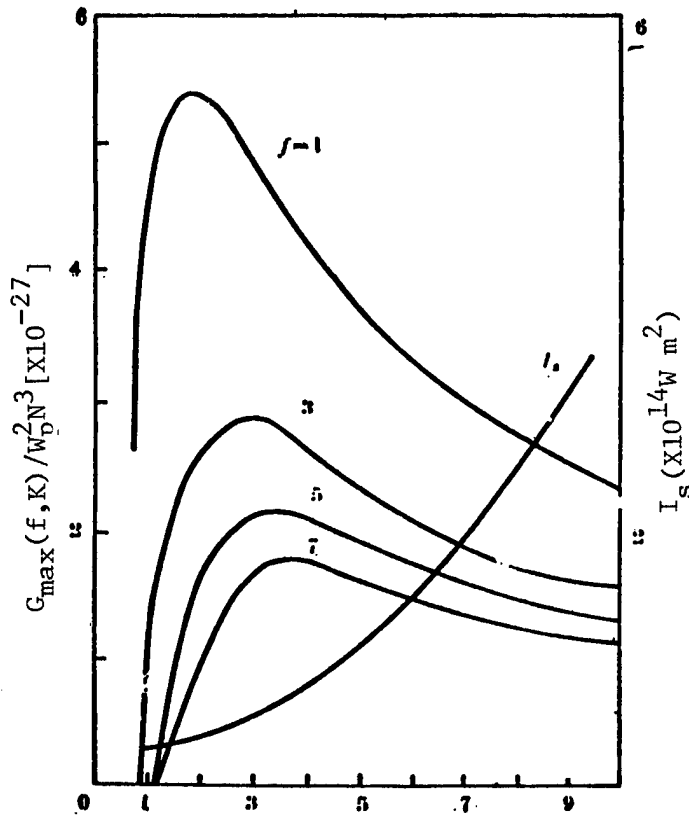


Figure 4. Gain of various harmonics versus K value when the fundamental is  $5300\text{\AA}$ . The curve shows the injected laser power for maximum gain.

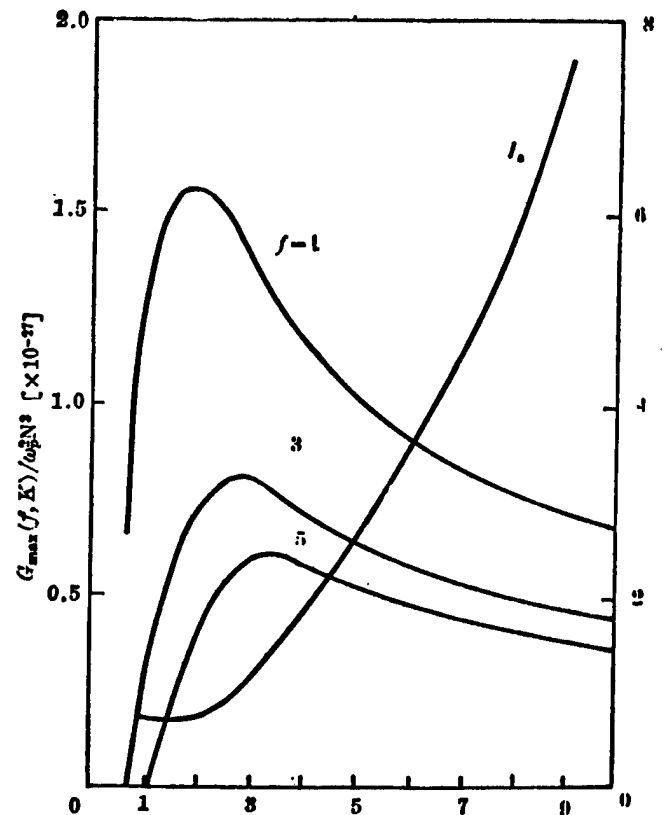


Figure 5. Gain of various harmonics versus K value when the fundamental is  $1.06\text{ m}$ . The curve shows the injected laser power for maximum gain.

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12966/9604

CSO: 4008/78

DETERMINATION OF RARE EARTH ELEMENTS BY LASER INTRACAVITY ABSORPTION  
SPECTROMETRY

Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 14 No 12,  
20 Dec 86 pp 914-917

[English abstract of article by Du Jixian [2629 4949 6343], et al., of  
Changchun Institute of Applied Chemistry, Chinese Academy of Sciences]

[Text] The absorption of six rare earth elements--xylend orange chelate--  
has been observed. The absorbances and molar absorptivity of the rare earth  
elements are compared with those obtained using a conventional spectrophoto-  
meter. The results show that the sensitivity of intracavity spectroscopy  
is about one order of magnitude higher than that of the conventional  
spectrophotometric method. (Paper received 5 Nov 85.)

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CSO: 4009/1104



EXTRACTION OF TRACE URANIUM (VI) WITH N-263-LOADED POLYURETHANE FOAM

Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 14 No 12,  
20 Dec 86 pp 930-933

[English abstract of article by Wang Mingsheng [3769 2494 0524], et al., of  
the Department of Chemistry, Wuhan University]

[Text] The effects of equilibrium time, pH of the aqueous phase, concentration of KSCN and U(VI), and foreign ions on the extraction have been examined. When the phase ratio was 1:2000 and the shaking time was over 40 minutes at room temperature, trace U(VI) at ppb levels could be almost quantitatively extracted by the N-263-loaded foam in 0.5M KSCN medium at pH 2.0, with a distribution ratio over  $3.1 \times 10^4$ . A new and rapid technique for preconcentration and extraction-spectrophotometric determination has been developed for U(VI) at ppb levels in bulky water samples. (Paper received 3 Jul 85.)

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CSO: 4009/1104

## STUDIES OF HIGHLY SENSITIVE COLOR REACTIONS OF NOBLE METALS (II). PALLADIUM-POTASSIUM IODIDE-BUTYLRHODAMINE B-ARABIC GUM-TRITON X-100

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 8 No 1, 28 Feb 86  
pp 4-7

[English abstract of article by Ci Yunxiang [1964 0061 4382], et al., of the  
Department of Chemistry, Beijing University]

[Text] A new hypersensitive color reaction of palladium (II) has been developed based on the formation of an ion-association complex of palladium (II) with potassium iodide and butylrhodamine B in the presence of arabic gum and triton X-100. The maximum absorption of the water soluble ion-association complex is at 610 nm, and its apparent molar absorptivity is  $1.4 \times 10^6 \cdot 1 \cdot \text{mole}^{-1} \cdot \text{cm}^{-1}$  at 610 nm. Beer's law is obeyed for 4 ~ 56 ng/ml of palladium. Definite amounts of  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , V(V),  $\text{Pt}^{4+}$ ,  $\text{Rh}^{3+}$ ,  $\text{Ir}^{3+}$ ,  $\text{Co}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Br}^-$ ,  $\text{F}^-$ ,  $\text{C}_2\text{O}_4^{2-}$  and  $\text{C}_4\text{H}_4\text{O}_6^{2-}$  showed no effect on the determination of microamounts of palladium, but metal ions  $\text{Au}^{3+}$ ,  $\text{Ag}^+$ ,  $\text{Cu}^{2+}$  and  $\text{Hg}^{2+}$  interfered seriously. (Paper received 20 Jul 84.)

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CSO: 4009/1108

## EFFECT OF ASSOCIATION BEHAVIOR OF ORGANIC REAGENT BY SURFACTANTS

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 8 No 1, 28 Feb 86  
pp 14-17, 30

[English abstract of article by He Xiwen [0149 6932 2429], et al., of the  
Department of Chemistry, Nankai University]

[Text] A number of organic reagents exhibit increasing disassociation in solution upon the addition of surfactants. This report concerns the studies to elucidate possible mechanisms of disassociation enhancement. The systems studied include reagents 2BL and direct violet 62 in the presence of cationic (hexadecyltrimethylammonium bromide--CTMAB), nonionic (triton X-100) and amphiprotic (DDMAA) surfactants.

Ultraviolet-visible spectrum studies of the reagents without surfactants in various solvent environments suggest that spectroscopic changes which occur upon micellar solubilization of the reagent may result from the increase in mononuclear molecules. (Paper received 12 Jul 84.)

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CSO: 4009/1108

STUDIES OF HIGHLY SENSITIVE COLOR REACTIONS OF NOBLE METALS (VI).  
 PLATINUM (II)-POTASSIUM IODIDE-BUTYLRHODAMINE B-GUM ARABIC-TRITON X-100 SYSTEM

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 8 No 3, 28 Jun 86  
 pp 131-134

[English abstract of article by Ci Yunxiang [1964 0061 4382], et al., of  
 the Department of Chemistry, Beijing University]

[Text] A new hypersensitive color reaction of platinum (II) has been developed based on the formation of an ion-association complex of platinum (II) with potassium iodide and butylrhodamine B in the presence of ascorbic acid, gum arabic and triton X-100. The absorption maximum of the aqueous soluble ion-association complex is at 620 nm, and its apparent molar absorptivity is  $1.0 \times 10^6 \text{ l} \cdot \text{mol}^{-1} \cdot \text{cm}^{-1}$  at 620 nm. Beer's law is obeyed for 10 ~ 120 ng/ml of platinum. Definite amounts of  $\text{Ir}^{3+}$ ,  $\text{Rh}^{3+}$ ,  $\text{Os(VIII)}$ ,  $\text{Ni}^{2+}$ ,  $\text{V(V)}$ ,  $\text{Fe}^{3+}$ ,  $\text{Co}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Cr(VI)}$ ,  $\text{Br}^-$ ,  $\text{C}_2\text{O}_4^{2-}$ ,  $\text{Zn}^{2+}$  and  $\text{Mg}^{2+}$  showed no effect on the determination of microamounts of platinum, while metal ions  $\text{Cu}^{2+}$ ,  $\text{Ag}^+$ ,  $\text{Au}^{3+}$ ,  $\text{Pd}^{2+}$ ,  $\text{Pb}^{2+}$  and  $\text{Hg}^{2+}$  interfered seriously. (Paper received 3 Jan 85.)

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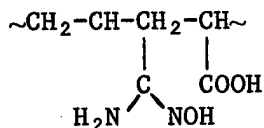
CSO: 4009/1108

## INVESTIGATION OF ENRICHMENT OF SOME METALLIC IONS WITH CHELATING FIBER P-3

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 8 No 4, 28 Aug 86  
pp 208-210

[English abstract of article by Hu Zhide [5170 0037 1795], et al., of the  
Department of Chemistry, Lanzhou University]

[Text] A new synthetic chelating fiber, P-3, was used as the chromatographic  
packing material. The structure of P-3 is



The experimental results obtained from infrared study show that the carboxyl group in P-3 interacted with metallic ions under the given conditions. The retention behavior of some metallic ions at different acidities was studied by chromatography and the conditions for enriching and recovering the metallic ions were obtained. The metallic ions were enriched when the pH value was equal to or higher than 9, and the enriched metallic ions were eluted and recovered when the concentration of  $\text{H}^+$  was equal to or more than 1.0 M. The method was used for the enrichment and recovery of metallic ions in waste water from factories. (Paper received 17 Feb 85.)

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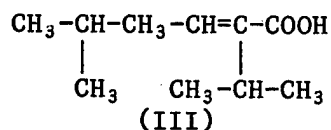
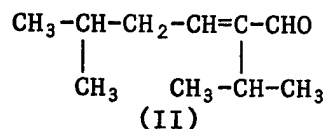
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SYNTHESIS AND STRUCTURE DETERMINATION OF  $\alpha$ -ISOPROPYL- $\beta$ -ISOBUTYL ACRYLIC ACID

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 8 No 5, 28 Oct 86  
pp 262-265

[English abstract of article by Ding Jianping [0002 1696 1627], et al., of the Department of Chemistry, Zhongshan University]

[Text] The  $\alpha$ -isopropyl- $\beta$ -isobutyl acrylic acid was synthesized from isopentylaldehyde in two steps, i.e., the condensation of isopentylaldehyde and the oxidation of  $\alpha$ -isopropyl- $\beta$ -isobutyl acrylaldehyde. The factors, e.g., reaction temperature, reaction time and NaOH concentration, which affect the yield of the product have been studied. The optimal oxidation conditions were established by an orthogonal test: reaction temperature, 40 ~ 50°C, reaction time, 6 ~ 10 hours, NaOH concentration, 7.5 ~ 12.5 percent. The structures were determined by UV, IR, MS and NMR. It is shown that  $\alpha$ -isopropyl- $\beta$ -isobutyl acrylaldehyde has the structure of (II),  $\alpha$ -isopropyl- $\beta$ -isobutyl acrylic acid has the structure of (III), and the ratio of cis to trans is 1:5.



(Paper received 4 Mar 85.)

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CSO: 4009/1108

ATOMIC ABSORPTION SPECTROMETRIC DETERMINATION OF TRACE ARSENIC IN MOS GRADE HYDROCHLORIC ACID BY GRAPHITE FURNACE AFTER EXTRACTION WITH AMMONIUM DI-SEC-BUTYLDITHIOPHOSPHATE

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 8 No 5, 28 Oct 86 pp 310-312, 293

[English abstract of article by Chen Youmin [7115 0327 2404], et al., of the Department of Chemistry, East China Normal University, Shanghai]

[Text] A procedure is described for the determination of trace arsenic in samples of MOS grade hydrochloric acid. It is based on the extraction of arsenic (III) with ammonium di-sec-butyldithiophosphate and measurement by graphite furnace atomic absorption spectrometry after re-extraction into water. Reduction of arsenic (V) to As (III) allows its complete extraction and determination. The calibration curve is linear up to 1500 ng arsenic. Quantities of arsenic as low as 100 ng (0.2 ppb when contained in 500 ml) can be determined. The relative standard deviation is 9.1 percent. The method has been applied to MOS grade hydrochloric acid samples. Good results have been obtained, with a recovery rate of 95 to 105 percent. (Paper received 30 Apr 85.)

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CSO: 4009/1108

## REACTION MECHANISM OF COBALT AND PYRIDYLazo-M-DIAMINO BENZENE COMPOUNDS

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 9 No 1, 28 Feb 87  
pp 1-3

[English abstract of article by Rong Qingxin [1369 1987 2450], et al., of  
the Department of Chemistry, Zhongshan University]

[Text] Cobalt existing in the trivalent state has low spin without unpaired electrons in its chelate with pyridylazo-m-diaminobenzene compounds. This was confirmed by magnetic susceptibility measurements and comparison of the visible spectra of the complexes of cobalt (II) sulfate and sodium cobalt-nitrite. Therefore, the stability of the cobalt complex toward acids can be explained by the ligand-field theory. A new structure of the chelate is suggested from its ultraviolet and infrared spectra. (Paper received 17 Sep 85.)

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CSO: 4009/1109



# SYNTHESIS OF NEW TYPE CHLOROPHOSPHOBISAZO REAGENTS OF ASYMMETRIC CHROMOTROPIC ACID AND THEIR COLOR REACTIONS WITH RARE EARTH, URANIUM, THORIUM AND ZIRCONIUM

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 9 No 1, 28 Feb 87  
pp 12-16

[English abstract of article by Dai Pingqi [2071 5493 4359], et al., of the Department of Chemistry, Wuhan University]

[Text] In this paper, two series of 3, 4, 5-trihalogenated and 2,6-dihalo-genated-4-nitro-chlorophosphobisazo reagents of asymmetric chromotropic acid have been designed and synthesized. These compounds have been purified and their compositions and structures have been identified. Their color reactions with rare earth, uranium, thorium and zirconium have been studied. Among these, the 2, 6-dibromo-4-nitro-chlorophosphoazo is a superior reagent for the spectrophotometric determination of rare earths. The ranges of acidity for reactions with rare earths are pH 1~2 (total rare earths) and 1~5 N HCl (cerium group rare earths). It is the highest among the reagents of the same type determined up to the present time. The rare earth complexes with the reagent have maximum absorption at about 641 nm and the molar absorptivity of gadolinium is  $\epsilon_{Gd} = 1.14 \times 10^5$ . The ranges of acidity for reactions with thorium and zirconium are 1~4 N and 1~3 N HCl respectively. The molar absorptivities of the complexes are  $9.11 \times 10^4$  and  $2.28 \times 10^4$  respectively. Therefore, this shows good prospects for the determination of thorium and zirconium.

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CSO: 4009/1109

STUDY OF SYNTHESIS OF WATER-SOLUBLE 5-Br-PAN-6S AND ITS ANALYTICAL PROPERTIES

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 9 No 2, 28 Apr 87  
pp 83-84, 125

[English abstract of article by Mao Xueqin [3029 7185 3830], et al., of the  
Department of Chemistry, Hangzhou University]

[Text] A water-soluble reagent, 1-[(5-bromo-2-pyridyl)azo]-2-naphthol-6-  
sulfonic acid (5-Br-PAN-6S) was prepared by sulfonation of 5-Br-PAN.

The two-step acid dissociation constants of the reagent were determined by  
the spectrophotometric method,  $pK_{a1} = 1.00$ ,  $pK_{a2} = 10.42$ . The color reaction  
of the reagent with various metal ions were studied, resulting in most of  
the reacting metals, except for palladium (II) (green) and iron (III) (brown),  
forming reddish chelates. (Paper received 8 Nov 85.)

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CSO: 4009/1109

## IC SIMULATION PROGRAM

Hefei ZHONGGUO KEXUE JISHU DAXUE XUEBAO [JOURNAL OF CHINA UNIVERSITY OF SCIENCE AND TECHNOLOGY] in Chinese Vol 17 No 1, Mar 87 pp 86-97

[English abstract of article by Zhao Ruimin [6392 4213 3046], et al., of the Division of Electrical Engineering and Electronics]

[Text] PSCNT 1.3 is an IC simulation program developed on a microcomputer. It runs faster, requires a smaller memory and has reliable convergence. The main algorithms of this program are introduced in this paper: Node-Tearing Algorithm, Order-Reduction Algorithm for Transistors, Simplified Sparse Matrix Technique and Modified Newton Linearization Algorithm. A practical computational example is also given. (Paper received 28 Apr 86.)

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## LEARNING METHOD WITH NEGATIVE-SAMPLE INFORMATION IN SYNTACTIC PATTERN RECOGNITION

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87  
pp 1-6

[English abstract of article by Yin Julian [1438 1565 3550] of Shanghai Teachers University]

[Text] A new kind of finite-state grammar is defined as T-degree similar derivation grammar  $G_{CDT}$  having parameter T. The structure of  $G_{CDT}$  not only depends on the positive sample set  $S^+$ , but is also controlled by parameter T. During grammatical inference, use can be made of the information provided by the negative sample set  $S^-$  to control T for modification of the inferred grammar. Therefore, the inferred grammar  $G_{CDT}$  meets the following requirements:

$$S^+ \subseteq L(G_{CDT}) \wedge S^- \subseteq \bar{L}(G_{CDT})$$

This learning method provides a satisfactory solution to the problem which, so far, had not been solved using finite-state grammar. The problem now is that the inferred grammar cannot be modified using the negative-sample information. (Paper received August 85; finalized March 86.)

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CSO: 4009/1100

# MICROPROCESSOR-BASED MEMORY-TAP ECHO CANCELER

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2,  
Mar 87 pp 18-24

[English abstract of article by Chen Xixian [7115 6932 0341], et al., of  
Beijing Institute of Posts and Telecommunications]

[Text] Echo cancellation in two-wire full-duplex data transmission is usually performed with data-driven transversal filters. In this paper, a new scheme for a microprocessor-based digital adaptive echo canceler is proposed. Since the estimated echo signals are directly derived from the binary data code, the amount of manipulation is reduced by a factor of three to five when compared with conventional manipulation. A theoretical analysis of adaptation convergence and computational complexity is given, and the convergence characteristic of MTEC is verified by computer simulations. (Paper received May 85; finalized March 86.)

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## HETEROJUNCTION BARRIER CONTROLLED BALLISTIC ELECTRON TRANSISTOR (HCBT)

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2,  
Mar 87 pp 25-31

[English abstract of article by Zhu Enjun [2612 1869 0971] of Beijing Electron  
Tube Factory]

[Text] The heterojunction barrier controlled ballistic electron transistor--  
a novel three terminal semiconductor device which can be operated competently  
at millimeter wavelength frequency--is proposed. The structure of this device  
is similar to that of the hot-electron transistor and its performance combines  
ther merits of a normal MESFET with a bipolar transistor. The high-frequency  
performance expected will be one decade better than that of a MESFET. (Paper  
received November 82; finalized May 1983.)

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## NONLINEAR MACROMODELS FOR INTEGRATED CIRCUIT OPERATIONAL AMPLIFIERS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2,  
Mar 87 pp 32-38

[English abstract of article by Wang Yuhong [3769 0056 1347], et al., of  
the Department of Electronic Engineering, Tianjin University]

[Text] Two nonlinear macromodels of operational amplifiers which are suitable for analyzing the time-domain and frequency-domain are presented respectively. The linear and nonlinear responses of OAs under the drive of different signal levels are considered. The nonlinear saturated current curve of the input stage and the analytical expressions are obtained. The innate physical properties are discussed according to the slew rate analogy. The simulation results are quite consistent with those of the experiments. (Paper received February 85; finalized March 86.)

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CSO: 4009/1100

CONVERSION CONTRIBUTION OF NONLINEAR JUNCTION CAPACITANCE OF MILLIMETER WAVE DIODES

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87 pp 39-44

[English abstract of article by Li Dunfu [2621 2415 1788], et al., of the University of Science and Technology of China]

[Text] A computing technique that saves much CPU time at a certain precision is proposed and applied to analyze the effects of the nonlinear junction capacitance of the millimeter wave mixer diodes. The results given are useful for engineering applications. (Paper received May 85; finalized January 86.)

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# ACTIVE RC SECOND-ORDER BANDPASS FILTERS WITH ACTIVE COMPENSATION

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87  
pp 55-61

[English abstract of article by He Jianshe [0149 1696 6080], et al., of Xi'an Jiaotong University]

[Text] Three active RC second-order bandpass filters with active compensation are introduced. A general formula for analyzing the shift in dominant poles is also presented. A simple approach based on an analysis of the location of the second-order parasitic poles is used to suppress the self-sustained high frequency oscillations usually found in these circuits. The experimental results basically agree with the theoretical analysis. (Paper received July 85; finalized February 86.)

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CSO: 4009/1100

## LARGE SIDE-APERTURE WAVEGUIDE COUPLERS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87  
pp 61-69

[English abstract of article by Yan Fang [0917 2455] of Shanghai University of  
Science and Technology]

[Text] The design formulae (in close form) for large side-aperture waveguide  
couplers are derived by means of the field matching method and relevant  
design charts for a variety of parameters which are also given using a  
computer. The present formulae are verified through the experimental data  
obtained from the published papers, as well as from available devices. The  
results obtained are compared in detail with those presented by N. L. Kogan.  
(Paper received April 85; finalized April 86.)

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CSO: 4009/1100

## BAND-LIMITED FUNCTION EXTRAPOLATION IN OPERATOR SPACE

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87  
pp 70-76

[English abstract of article by Kong Fannian [1313 0416 1628], et al., of the  
Institute of Electronics, Chinese Academy of Sciences, Beijing]

[Text] Band-limited function extrapolation can be considered as an approximation problem in operator space, and the Papoulis-Gerchberg method corresponds to the case of approximation using the Taylor series. A new iterative extrapolation algorithm, based on the Landzos approximation, is proposed. Theoretical and numerical analyses show that the new method has a much faster convergence rate than does the Papoulis-Gerchberg method. (Paper received June 85; finalized November 85.)

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E/D NMOS VOLTAGE REFERENCE

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87  
pp 76-82

[English abstract of article by Gong Mingfu [7895 2494 3940], et al., of  
Qinghua University, Beijing]

[Text] This paper discusses the design method of the E/D NMOS high stability voltage reference. Based on R.A. Blauschild's thoery, some new results and formulas are obtained, and a new NMOS voltage reference with temperature coefficient trimmable-on-chip is achieved. The circuit design is simulated with SPICE-II, and the test chip experiment shows satisfactory results. (Paper received April 85; finalized October 85.)

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CSO: 4009/1100

PLACE EXCHANGE METHOD FOR PRECISE PHASE SHIFT MEASUREMENT OF LARGE MICROWAVE SYSTEMS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87 pp 93-97

[English abstract of article by Yin Liansheng [3009 6647 3932] of Nanjing Research Institute of Electronic Technology]

[Text] The phase shift of amplitude difference between any two channels in microwave main system feeds or monitor system feeds can be accurately measured by the method described here. The accuracy of the phase shift method is about  $1^\circ$ . This method can also distinguish the phase shift of microwave main system feeds from the monitor system feeds, and can be used to adjust microwave systems, thus being of value in applying and repairing. (Paper received April 85; finalized December 85.)

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CSO: 4009/1100

APPLICATION OF HYDROGENATED AMORPHOUS Si PASSIVATION FILM TO Si DEVICES

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87  
pp 105-107

[English abstract of article by Du Jiafang [2629 1367 2455], et al., of Nanjing University; Zhang Xiaomin [1728 2556 2494], et al., of the Solid State Device Institute of Nanjing; Li Shoulin [2621 1108 2651], et al., of Shanghai No 29 Radio Factory]

[Text] The application of hydrogenated amorphous silicon (a-Si:H) passivation film to power transistors is reported in this paper. Experimental results show that the passivation film contributes to improvement of the electrical properties and to the prevention of p-n junction contamination, therefore improving the reliability and stability of the devices. The passivation mechanism is also discussed. (Paper received September 85; finalized January 86.)

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CSO: 4009/1100

## INVESTIGATION OF ELECTRICAL AND OPTICAL PROPERTIES OF a-GaAs FILMS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 15 No 2, Mar 87  
pp 108-110

[English abstract of article by Yang Zuoya [2799 1563 1246], et al., of the  
Department of Physics, Nanjing University]

[Text] Systematic studies on physical properties of a-GaAs films prepared by PECTD (Plasma Enhanced Chemical Transport Deposition) method are carried out. At room temperature the undoped a-GaAs films appear as N-type, with electron drift mobility of  $10^{-2} \sim 10^{-3} \text{ cm}^2/\text{V.s.}$  It is found that an excess of Ga elements and the existence of Cl atoms in the a-GaAs films will change the physical properties. Theoretical models are suggested to explain the above phenomena. (Paper received May 85; finalized March 86.)

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CSO: 4009/1100

EFFECT OF SHEAR STRESS ON SENSITIVITIES OF PIEZORESISTORS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 5, Sep 86 pp 522-530

[English abstract of article by Wang Yan [3769 6056], et al., of the Institute of Microelectronics, Fudan University]

[Text] Two-dimensional analyses of piezoresistive sensitivities of resistors on (100), (110), (111) square, rectangular and circular silicon diaphragms are made, and results both with and without shear stress being taken into consideration are presented and compared in graphic form. To verify the theoretical results, experimental devices are made and the angular dependencies of the piezoresistive sensitivity of p type resistors at the center of a rectangular diaphragm are observed. The results agree with the expected curve very well. Therefore, some of the design rules should be changed according to these results. (Paper received 26 Jul 85.)

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CSO: 4009/1105



## ELLIPSO-METRIC STUDY OF ROUGH SURFACES OF SILICON AND IMPROVED OL MODEL

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 5, Sep 86 pp 531-538

[English abstract of article by Liu Ansheng [0491 1344 0524], et al., of the  
Department of Physics, Zhongshan University]

[Text] The ellipsometric spectra of ground-annealed silicon have been measured and analyzed with the Ohlidal-Lukes model and the effective medium theory. It has been found that the ellipsometric spectra do not completely agree with either the OL model or the effective medium theory. An improved OL model is proposed by combining the OL model with the effective medium theory, and it agrees with the experimental results better than the OL model or the effective medium theory. (Paper received 22 Jun 85.)

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CSO: 4009/1115

TRANSIENT ANNEALING OF ION IMPLANTED Si AND DLTS STUDY OF RESIDUAL DEFECTS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 5, Sep 86 pp 547-550

[English abstract of article by Fan Yongping [5400 3057 1627], et al., of  
Xi'an Jiaotong University]

[Text] Transient annealing with a heated graphite stripe has been studied. Solid-phase epitaxial recrystallization of ion implantation induced amorphous layers in Si has been proved using the layer striping ellipsometric method. The experimental results show that the electrical activation is comparable to or better than that obtained by conventional furnace annealing, but with negligible redistribution of implanted impurities. DLTS measurements have been performed on low dose B<sup>+</sup>-implanted MOS structures. For a dose of  $1 \times 10^{12} \text{ cm}^{-2}$ , annealing at 950°C for 30 minutes with a conventional furnace and annealing with a heated graphite stripe, one deep level for each annealing process has been found. The possible assignments for these deep levels are also discussed. (Paper received 11 Jul 85.)

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CSO: 4009/1115

$\text{Pb}_{0.88}\text{Sn}_{0.12}\text{Te}$  CRYSTAL ANNEALING CHARACTERISTICS AND ITS APPLICATION TOWARD FABRICATING LASER

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7 No 5, Sep 86 pp 551-554

[English abstract of article by Chen Heming [7115 7729 2494], et al., of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] The  $\text{Pb}_{0.88}\text{Sn}_{0.12}\text{Te}$  crystal annealing characteristics are discussed. The authors present relationships of the conversion layer depth (P-N junction depth) to annealing time and temperature. Also given are tuning characteristics of tunable diode lasers made by the crystal. (Paper received 13 Jul 85.)

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CSO: 4009/1115

# PRELIMINARY STUDY OF ROLE OF DISLOCATION IN UNDOPED SEMI-INSULATING GaAs CRYSTALS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7 No 5, Sep 86 pp 558-560

[English abstract of article by Mo Peigen [5459 1014 2704], et al., of Shanghai Institute of Metallurgy, Chinese Academy of Sciences]

[Text] The effects of EPD on the  $I_L$ , deep trap levels characterized by PITS and Hall measurements at different temperatures and the uniformity evaluated from the  $I_{DS}$  of FET fabricated by Si ion implantation in undoped SI GaAs crystals grown by LEC and LEF methods are studied. It is found that the  $I_L$  is inversely proportional to EPD for the high EPD wafers, whereas no such relationship exists when the EPD in LEF wafers is low enough. These results, in conjunction with the main deep trap level measurements, show that the deep trap level in the low EPD wafers should be different from EL2 observed in the conventional LEC ones. The effect of EPD on the variation of  $I_{DS}$  of FET has also been found. The results show that the lower value of EPD may help to improve the electrical uniformity of undoped SI GaAs crystals. (Paper received 12 Aug 85.)

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## DESIGN AND ANALYSIS OF HIGH PERFORMANCE 16K (2Kx8) NMOS-SRAM

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 6, Nov 86 pp 573-581

[English abstract of article by Xu Jiasheng [1776 5521 3932], et al., of the  
Institute of Microelectronics, Qinghua University]

[Text] A high performance 16K (2K x 8) NMOS-SRAM is designed and fabricated using double poly-Si NMOS technology based on the 3  $\mu$ m design rule. The chip architecture, memory cell, sense amplifier and decoder circuits are analyzed and optimized. The results of CAD circuit simulation are quite close to those obtained through testing. The access time is 120 ns and the power dissipation is 150 mW. (Paper received 20 Jan 86.)

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(Revised Oct. 1980).

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CSO: 4009/1116

## THREE-DIMENSIONAL CMOS IC TECHNOLOGY AND CHARACTERISTICS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 6, Nov 86 pp 582-588

[English abstract of article by Qian Peixin [6929 0160 0207], et al., of the  
Institute of Microelectronics, Qinghua University]

[Text] This paper reports a three-dimensional CMOS IC's technology and characteristics. N-MOS transistors have been fabricated on a p-type single crystal silicon substrate. P-MOS transistors have been fabricated in n-type silicon on insulator films prepared using CW Ar<sup>+</sup> laser beam recrystallization. An LPCVD SiO<sub>2</sub> layer is an insulator between N-MOS and P-MOS transistors. Nine-stage 3D-CMOS ring oscillators with a 5  $\mu$ m channel length are made with a propagation delay of 2.7 ns each. (Paper received 14 Nov 85.)

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CSO: 4009/1116

SILICON EPITAXY OF  $\text{SiCl}_4$ - $\text{SiH}_4$ - $\text{H}_2$  SYSTEM

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 6, Nov 86 pp 602-607

[English abstract of article by Tang Guangping [3282 1639 1627], et al., of the  
Department of Electronics Sciences, Jilin University].

[Text] The silicon epitaxy of the  $\text{SiCl}_4$ - $\text{SiH}_4$ - $\text{H}_2$  system has been studied. The results obtained show that the  $\text{SiCl}_4$ - $\text{SiH}_4$  mixed source is better than  $\text{SiCl}_4$  or  $\text{SiH}_4$  used separately, and that when mixed in suitable proportions it may be used to substitute for  $\text{SiH}_2\text{Cl}_2$ . This mixed source may decrease the temperature of epitaxy, control the velocity of silicon growth, improve the homogeneity of silicon epitaxy and restrain the autodoping effect. The mixed source epitaxy may satisfy different conditions for the preparation of different kinds of semiconductor devices. (Paper received 31 Aug 85.)

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CSO: 4009/1116

## ANALYSIS OF HETEROGENEOUS INTERFACE OF p(a-SiC:H)/i(a-Si:H)

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 6, Nov 86 pp 608-611

[English abstract of article by Chen Zhizhang [7115 0037 4545], et al., of the  
Department of Electronic Science, Nankai University]

[Text] This paper deals with the phenomenon that the contamination of C in the i layer of glass/ITO/p(a-SiC:H)/i(a-Si:H)/n(a-Si:H)/Al solar cell will seriously influence the open circuit voltage  $V_{oc}$  fill factor FF, length of collection  $L_c$  and coefficient of collection  $\eta$ . A detailed analysis of the phenomenon is given in this paper. The authors' experimental results indicate that the key to making high conversion efficiency in amorphous solar cells is to control the contamination of C in the i layer and prepare a good p/i interface. (Paper received 6 Sep 85.)

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CSO: 4009/1116



## FABRICATION OF LOW THRESHOLD CURRENT CONSTRICTED DOUBLE-HETEROJUNCTION LASERS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 6, Nov 86 pp 624-630

[English abstract of article by Du Guotong [2629 0948 0681] and Xiao Jianwei [5135 1696 0251], et al., of the Department of Electronics Science, Jilin University; Yang Delin [2799 1795 2651] of Chongqing Institute of Opto-electronics]

[Text] The constricted double-heterojunction lasers with low threshold current have been fabricated. At present the lowest threshold is 27.5 mA (CW, 21°C, cavity length  $L = 125 \mu\text{m}$ ). Two main problems in decreasing the threshold current--the quality of the epitaxial layers and the effects of current spreading--are discussed, and the approximate formula for current profile for the CDH structure is given. (Paper received 21 Sep 85.)

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CSO: 4009/1116

CHOICE AND APPLICATION OF OPTIMAL TECHNICAL PARAMETERS IN PREPARING CVD  $\text{Si}_3\text{N}_4$  FILMS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7 No 6, Nov 86 pp 631-637

[English abstract of article by Ruan Chuantu [7086 0278 0960] of the 7th Radio Factory of Shanghai]

[Text] The deposition process in the preparation of LPCVD  $\text{Si}_3\text{N}_4$  films is studied in detail. Some relationships between the technical parameters and qualities of deposited films are discussed for certain conditions of pressure, gas flow and temperature distribution. The optimal technical parameters of pressure, gas flow and temperature distribution are obtained through cross testing. LPCVD  $\text{Si}_3\text{N}_4$  films of good quality and good uniformity are prepared. Both the quality and the uniformity of the deposited  $\text{Si}_3\text{N}_4$  films have moved up to advanced world standards of similar products prepared abroad. The LPCVD  $\text{Si}_3\text{N}_4$  films have been used as mask layers for about 40,000 bipolar devices in the past year. Compared with the  $\text{Si}_3\text{N}_4$  films deposited by the normal pressure CVD technique, when the  $\text{Si}_3\text{N}_4$  films prepared by the LPCVD technique are used the qualified rate of products is improved by 33.2 percent, the efficiency of production is raised more than 10 times, and the reliability of the devices is greatly improved. Obvious commercial benefit is obtained. (Paper received 28 Sep 85.)

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CSO: 4009/1116

STUDY OF ION IMPLANTATION RESISTED ETCHING TECHNIQUE

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 6, Nov 86 pp 638-642

[English abstract of article by Han Jieping [7281 0094 1627], et al., of the  
Institute of Semiconductors, Chinese Academy of Sciences]

[Text] A new technique has been developed for reducing the  $\text{SiO}_2$  etching rate using ion implantation. Various ions are implanted into  $\text{SiO}_2$  layers with different doses. The experimental results show that the higher the dose, the lower the etching rate. The key point of this process is the catalyst and dry etching. These results are opposite those of ion implantation enhanced etching by the wet method reported by other authors. The advantages of this technique include good selectivity, high resolution, reagent saving and easy operation. (Paper received 31 Dec 85.)

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CSO: 4009/1116

## MBE GROWTH OF HIGH QUALITY P-TYPE GaAs FILMS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7  
No 6, Nov 86 pp 658-660

[English abstract of article by Liang Jiben [2733 1015 2609], et al., of the  
Institute of Semiconductors, Chinese Academy of Sciences]

[Text] High quality P-type GaAs films have been grown through a homemade molecular beam epitaxy system. Undoped GaAs films are found to be of the P-type with free hole concentration  $(2-8) \times 10^{14} \text{ cm}^{-3}$  and mobility  $360-400 \text{ cm}^2/\text{V}\cdot\text{s}$  at room temperature. P-type GaAs films are doped with Be of 99.5 percent purity which has been "purified" by the authors. The mobilities as a function of free hole concentrations ranging from  $1.0 \times 10^{15}$  to  $6 \times 10^{19} \text{ cm}^{-3}$  are in agreement with the empirical curve at room temperature. P-type GaAs films have been measured and studied with photoluminescence at 4.2 K. (Paper received 12 Jul 85.)

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CSO: 4009/1116

## Au-Si EUTECTIC ALLOY LIQUID METALLIC ION SOURCE

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 7 No 6, Nov 86 pp 668-671

[English abstract of article by Zhang Libao [1728 4539 1405], et al., of the Institute of Semiconductors, Chinese Academy of Sciences]

[Text] An Au-Si alloy ion source has been developed using an alloy with atomic ratio of 69 percent Au and 31 percent Si. The method for fabricating the ion source, the I-V characteristics and the changes of all ion peak values with different ion source currents are described. The results of mass spectrum analysis are discussed. The atomic flux ratios (percent) of ion compositions  $\text{Si}^+$ ,  $\text{Si}^{++}$ ,  $\text{Si}_2^+$ ,  $\text{Au}^+$  and  $\text{Au}^{++}$  are measured for a long period of time. The life-time of the source is over 140 hours. (Paper received 2 Sep 85.)

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CSO: 4009/1116

EFFECT OF CARRIER LEAKAGE OVER HETEROBARRIER ON  $T_0$  OF InGaAsP SEMICONDUCTOR LASERS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8 No 2, Mar 87 pp 122-129

[English abstract of article by Guo Changzhi [6753 7022 1807], et al., of the Department of Physics, Beijing University]

[Text] The influences of energy band structure parameters and transport mechanisms on carrier leakage by quasiequilibrium carriers over the hetero-barriers of InGaAsP/InP DH lasers, lasing at a wavelength of  $1.3 \mu\text{m}$ , and the confusion made by recent experimental results on carrier leakage are analyzed. It is shown that the quasiequilibrium leakage processes can never play an important role in  $T_0$ , and that the leakage current measured may be due to the leakage of the hot carriers produced by Auger recombinations, which still may be mainly of the CHCC process. (Paper received 3 Dec 85.)

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CSO: 4009/1119

## STUDY OF ELECTRICAL CHARACTERISTICS AND C-V DEPENDENCE OF MISIS STRUCTURE

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8  
No 2, Mar 87 pp 145-151

[English abstract of article by Chen Hui [7115 2547], et al., of the Institute of Microelectronics, Qinghua University]

[Text] The characteristics of uniformly doped MISIS structure are simulated by solving a one-dimensional Poisson equation, and the influence of the thickness of the top silicon layer upon the potential distribution and carrier density distribution in this structure is studied. The results of simulation show that when the gate voltage  $V_G$  is applied to the MISIS structure, a depletion layer and an accumulation layer always coexist on the top of the silicon layer. There is at least an electrically neutral point in this layer. When the thickness of the top silicon layer is about 1.6 times larger than the maximum thickness of the depletion layer, the electrical characteristics of the MISIS structure are independent of this thickness. The ideal capacitance/voltage dependence of the MISIS structure is derived based on the former simulation in the absence of surface states, and the results are qualitatively verified by the experiment. The study shows that parameters, such as doping concentration in both silicon layers and insulator thickness of the MISIS structure, can be estimated from the C(V) measurement in comparison with the theoretical calculation just as in the case of the conventional MIS structure. (Paper received 3 Jan 86.)

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CSO: 4009/1119

## NEW InP MIS STRUCTURE WITH DOUBLE INSULATORS

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8  
No 2, Mar 87 pp 152-159

[English abstract of article by Wang Zhengxiao [3076 2973 1321] of the  
Institute of Semiconductors, Chinese Academy of Sciences]

[Text] This paper presents a new InP MIS structure with double insulators which is composed of a thin layer of SiO deposited by vacuum evaporation and a very thin layer of native oxide of InP which grows thermally in the P<sub>2</sub>O<sub>5</sub> atmosphere. Measurements of high frequency C-V characteristics of this structure show good interface performances in which the minimum interface density is about  $8.5 \times 10^{10} \text{ cm}^{-2}\text{eV}^{-1}$ . In addition, based on the results of AES measurements, the role of the very thin layer of InP native oxide is discussed in order to improve the interface performances of the InP MIS structure. (Paper received 13 Feb 86.)

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CSO: 4009/1119



LOW DISLOCATION DENSITY SI-GaAs BY DOPING WITH ISOELECTRONIC IMPURITY-In

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8 No 2, Mar 87 pp 204-206

[English abstract of article by Lin Lanying [2651 5695 5391], et al., of the Institute of Semiconductors, Chinese Academy of Sciences]

[Text] Low dislocation density SI-GaAs crystals have been pulled from melts by doping with isoelectronic impurity-In. The etch pit density of SI-GaAs crystals can reach the order of  $10^2/\text{cm}^2$ . There is no microprecipitate of indium in the crystals. (Paper received 18 Dec 85.)

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CSO: 4009/1119

## ELECTRON RADIATION EFFECT ON PLATINUM-RELATED DEEP LEVELS IN SILICON

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8  
No 2, Mar 87 pp 207-209

[English abstract of article by Gong Min [7895 2404], et al., of the Department of Physics, Sichuan University]

[Text] The reduction of the  $E_c-0.23$  eV DLTS signal in platinum deoped silicon by electron irradiation has been observed. The platinum-related level  $E_c + 0.32$  eV is not susceptible to electron radiation. This experiment leads the authors to suggest that the two levels in platinum doped silicon are not related to the same center. (Paper received 30 Dec 85.)

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CSO: 4009/1119

ANALOG MULTIPLIER-DIVIDER REALIZED IN CMOS/TTL COMPATIBLE TECHNOLOGY

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8  
No 2, Mar 87 pp 210-213

[English abstract of article by Hong Zhiliang [3163 1807 5328] of the Institute of Microelectronics, Fudan University; Hans Melchior of the Swiss Federal Institute of Technology, Zurich]

[Text] An analog four-quadrant multiplier-divider realized in CMOS/TTL compatible technology is reported. Experimental results show that this circuit has good linearity--the nonlinearity is less than 1 percent even when the inputs range to half the supply voltages. Small offset voltages and great dynamic ranges are present. (Paper received 28 Dec 85.)

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CSO: 4009/1119

PROPERTIES OF Mg DOPED GaAs AND  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  GROWN BY LPE AT  $700^\circ\text{C}$ 

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8  
No 2, Mar 87 pp 214-217

[English abstract of article by Liu Hongxun [0491 1347 8113], et al., of the  
Department of Physics, Beijing University]

[Text] Properties of Mg doped GaAs,  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  grown by LPE at  $700^\circ\text{C}$  are investigated. The hole concentration and mobility of Mg doped GaAs,  $\text{Al}_{0.53}\text{Ga}_{0.47}\text{As}$  have been measured in the temperature range of 77-300 K. The dependence of hole concentration on the composition of Mg in liquid is obtained, and the distribution coefficient of Mg in GaAs at  $700^\circ\text{C}$  is estimated. (Paper received 3 Jan 86.)

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CSO: 4009/1119

# PROPERTIES OF HIGH DOSE As<sup>+</sup> IMPLANTED SILICON ANNEALED AT LOWER TEMPERATURE BY ELECTRON BEAM

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8 No 2, Mar 87 pp 218-221

[English abstract of article by Lu Diantong [4151 3013 6639], et al., of the Institute of Low Energy Nuclear Physics, Beijing Normal University; Gao Yuzun [7559 1937 1415] of Beijing General Research Institute for Nonferrous Metals]

[Text] Properties of high dose As ion implanted <111> silicon annealed at a lower temperature and by an electron beam have been investigated. If the silicon specimens are only annealed at a higher temperature or by an electron beam, the density of defects is about  $10^9/\text{cm}^2$ , the lengths of dislocations or other defects are up to 2-4  $\mu\text{m}$ , and the dislocation loops and networks are observed in the implanted layer. After two-step annealing--a lower temperature thermal annealing followed by a higher temperature electron beam annealing--the density of defects is decreased by one order at least. The length of dislocation is less than 0.5  $\mu\text{m}$ . No dislocation networks have been observed. (Paper received 28 Oct 85.)

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CSO: 4009/1119

## EXPERIMENTAL RESULTS FOR CCTS BISTABLE DH LASER

Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 8  
No 2, Mar 87 pp 222-224

[English abstract of article by Li Jianmeng [2621 1696 5536], et al., of the  
Institute of Semiconductors, Chinese Academy of Sciences]

[Text] Experimental results are presented regarding a Ridge-Waveguide stripe  
structure bistable In-GaAsP/InP laser formed by a SiO<sub>2</sub> cover. There is a Q-  
switched modulation due to the saturable absorber in it. The characteristics  
of I-L, spectra and threshold currents relative to the temperature and  
spectral exciting state are measured. (Paper received 4 Aug 86.)

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CSO: 4009/1119

DEVELOPMENT IN PRODUCING PRECISION CASTING DIE WITH CERAMIC MOLD

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY]  
in Chinese Vol 10 No 2, Apr 87 pp 17-24

[English abstract of article by Zhao Suqin [6392 3219 3830], et al., of the  
Department of Mechanical Engineering]

[Text] In this paper, the influence factors on the dimension precision and the ceramic mold finish are researched. Based on this test, the optimum parameters are selected. Two new kinds of organic catalyzers and a new technique--the so-called dipping stable liquid treatment--are successfully developed, thus improving the precision and surface smoothness of the ceramic mold. As a result, the smoothness of the precision casting die produced is up to grade  $\nabla 6$ . (Paper received 4 Aug 86.)

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CSO: 4009/1113

NATURAL LANGUAGE CONCEPTUAL STRUCTURE ABSTRACTION APPROACH AND ITS MAN-MACHINE DIALOG MODEL

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese  
Vol 10 No 2, Apr 87 pp 34-39

[English abstract of article by Wu Haodong [0702 3185 2639], et al., of the Department of Computer Science]

[Text] In this paper the authors present a natural language processing approach based on fuzzy semantic recognition. The basic idea of this approach lies in extracting a conceptual structure that contains the semantic information from the user's input, based on semantic patterns and dialog environment. As a consequence, no complicated analysis of syntactic structure is needed and the recognition procedure can apparently be speeded up.

This paper describes the principle of the conceptual structure approach and its man-machine dialog model. The feasibility and effectiveness of this approach are discussed as well. (Paper received 17 Dec 85.)

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CSO: 4009/1113



## STUDIES OF FATIGUE PROCESS OF 20SiMnV STEEL BY RESIDUAL STRESS AND POSITRON LIFETIME SPECTRA

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese  
Vol 10 No 2, Apr 87 pp 40-45

[English abstract of article by Hu Zhenji [5170 2182 4764], et al., of the Metallurgy and Materials Engineering Department; Lin Shangjin [0491 1424 6651] of the Applied Physics Department]

[Text] In this article, the positron lifetime spectra and residual macro-stress of 20SiMnV steel fatigue are measured. The fatigue fracture, slip bands of the surface and change of the dislocation structure are observed. The results show that, as the cyclic times increase, the positron annihilation lifetime and intensity appear periodically charged; the residual macro-stress increases some times and decreases other times. The periodicity of the positron annihilation parameter is related to the periodic change of lattice distortion and crystal defect. The slip process proceeds gradually and causes the saving and freeing of residual stress on the surface of the sample to proceed alternately, thereby increasing the residual stress some times and decreasing it other times. As the layer depth increases, the dislocation density decreases. This corresponds to the decreasing of plastic deformation along the depth of the layer. (Paper received 1 Aug 85.)

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SOLVING THE UNIT COMMITMENT PROBLEM OF CASCADE HYDROPOWER STATIONS BY METHODS OF FUZZY MATHEMATICS AND NONLINEAR PROGRAMMING

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese  
Vol 10 No 2, Apr 87 pp 93-104

[English abstract of article by Chen Keju [7115 0344 5282] of the Office of Computation, Chongqing Planning Committee; Duan Yurong [3008 5713 2837], et al., of the Applied Mathematics Department, Chongqing University]

[Text] In this paper the authors have built a nonlinear programming mathematical model of optimal unit commitment of cascade hydropower stations using fuzzy mathematics. Using the mixed penalty function method SUMT, in this model the authors transform constrained nonlinear programming into a sequence of unconstrained minimization problems, solving the unconstrained problems using the variable metric method DFP and the quadratic interpolation method. The authors can determine a comparatively optimal unit commitment with the synthetic criteria of fuzzy mathematics. (Paper received 12 Jul 86.)

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CSO: 4009/1113

## METHOD FOR ANALYZING THREE-DIMENSIONAL OCEANIC LONG WAVE MOTION\*

Beijing HAIYANG YU HUZAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 18  
No 3, May 87 pp 237-243

[English abstract of article by Li Chunyan [2621 2504 7159], et al., of the  
Institute of Oceanology, Chinese Academy of Sciences, Qingdao]

[Text] It is suggested in this paper that the horizontal components of velocity in the oceanic long wave motion be expressed by the vertically averaged velocity and the deviate velocity. A set of equations, including the vertically averaged velocity, the water height, the deviate velocity and the surface stress as variables, is deduced for the study of the long wave motion. A nonlinear analytical solution of a low atmospheric pressure induced motion is found using the method. Some nonlinear effects and resonance phenomena are discussed. (Paper received 29 Apr 85.)

\* Contribution No 1201 from the Institute of Oceanology, Chinese Academy of Sciences.

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## DISCOVERY OF IRON COSMIC SPHERULES WITH GOLDEN Ni-Fe CORE IN DEEP-SEA SEDIMENTS

Beijing HAIYANG YU HUZAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 18  
No 3, May 87 pp 244-252

[English abstract of article by Peng Hanchang [1756 3352 2490], et al., of the First Institute of Oceanography, SOA, Qingdao; Institute of Hunan Metallurgical Industry, Changsha; The China Research Institute of Colored Metallurgical Cooperation, Guilin]

[Text] Recently, several thousand cosmic spherules containing iron spherules (83 percent), silicate spherules (15 percent) and glassy spherules (2 percent) were found in the deep-sea sediments from the northern Pacific (158-178°W, 7-11°N). Iron spherules with button-shaped structures reached 5.7 percent.

The authors first found a golden Ni-Fe core in the naturally broken iron spherules of globular, ellipsoid or oblate spheroid shapes with strong metallic luster and rough surfaces. Because of their hardness, they could be easily dislocated from the crust. Scanning electron microscopic analysis and electron probing analysis indicated a very high content of Ni (28-79 percent) and Co (0.55-1.89 percent), and a small amount of Cu, Cr, Au, etc.

This finding is of significance for further ascertaining the origin and formation of deep-sea cosmic spherules. (Paper received 7 Aut 85.)

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APPLICATION OF PRINCIPLE OF LEAST  $\Sigma$  TO CHEMICAL MODEL OF NATURAL WATER

Beijing HAIYANG YU HUZAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 18 No 3, May 87 pp 273-279

[English abstract of article by Hong Jihua [3163 4949 5478], et al., of the Chinese Academy of Environmental Sciences, Beijing]

[Text] Applying the classification of HSAB and the principle of least  $\Sigma$ , the chemical models of major constituents ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{HCO}_3^-$ ,  $\text{CO}_3^{2-}$ ,  $\text{SO}_4^{2-}$  and  $\text{Cl}^-$ , etc.) in water bodies of different aqueous chemical types are developed in this paper. The differences among the models in various areas and the transformation of chemical models in the various evolutionary steps of lakes are discussed. A chemical model of 26 trace elements in the waters is also studied and the dominant complexes of those elements are calculated. The results show that metal ions of the soft and intermediate acids exist mainly as Me-Cl; the hardest acid ( $\phi_A > 2.06$ ) in salt lakes forms mainly Me-F complexes; sub-hard acid ( $0.64 < \phi_A < 2.06$ ) principal speciation is free ions. In fresh water lakes, trace elements belonging to hard acids exist mainly as free ions. (Paper received 16 Aug 83.)

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## ELECTROCHEMICAL EVALUATION OF DISSOLVED CHARACTERISTICS OF Al BASIC SACRIFICIAL ANODES IN SEAWATER

Beijing HAIYANG YU HUZAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 18, No 3, May 87 pp 309-312

[English abstract of article by Zhang Jinglei [1728 4842 4320], et al., of the Institute of Oceanology, Chinese Academy of Sciences, Qingdao]

[Text] The surface dissolved characteristics of Al basic sacrificial anodes in seawater have never been expressed numerically except in words such as uniform dissolution, non-uniform dissolution, serious localized dissolution, etc. An electrochemical method was developed in the authors' laboratory to evaluate the above-mentioned characteristics quantitatively. The Al anode samples are polarized potentiostatically to  $-1000$  mV (vs Ag/AgCl reference electrode) in seawater at  $25 \pm 1^\circ\text{C}$ , and anodic current-time curves are recorded simultaneously. Then the Coulomb densities are calculated with a planimeter. By comparing the Coulomb densities of these samples, the surface dissolved characteristics of anodes can be evaluated quantitatively. (Paper received 4 Nov 85.)

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## ENVIRONMENTAL QUALITY

### SHENZHEN ENVIRONMENTAL OFFICIAL SPEAKS TO PRESS

OW021650 Beijing XINHUA in English 1454 GMT 2 Jun 87

[Text] Shenzhen, 2 Jun (XINHUA)--The water in two major reservoirs in Shenzhen is of excellent quality, the Shenzhen environmental protection office announced at a press conference here today.

Water in the Shenzhen Gulf, the Lang Gulf and the Zhujiang Estuary is also of a similar high quality, an official from the office said.

"The air is also clean," he said. The average daily content of sulfur bichloride is monitored at 0.009 mg per cubic meter--much lower than the first-class standard of 0.02 mg per cubic meter.

The atmosphere in Shenzhen, which is a special economic zone, contains the least sulfur bichloride among all Chinese cities.

Local residents also enjoy more trees and lawns than other cities, with each sharing 6.6 square meters of green area. The tree coverage in the city has reached 36 percent.

However, environmental officials expressed worry about the worsening water pollution in rivers and lakes in the city due to negligence by nearby factories and quarries.

"Noise pollution is also becoming serious in the downtown areas," an official said.

The local environmental departments are working on new programs for sewage treatment and improving the quality of river water, with the cooperation of Hong Kong, and the Shenzhen sewage treatment plant is now undergoing an expansion project.

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CS0: 4008/2021

ECOLOGISTS CITES PROBLEMS OF POLLUTION

OW201253 Tokyo KYODO in English 1105 GMT 20 Jun 87

[Text] Nagoya, 20 Jun (KYODO)--Heavily polluting industries exiting Chinese cities to escape strict emission codes are moving to rural coastal areas where they are causing severe environmental problems, a Chinese ecologists said Saturday.

Wang Rusong, a director at the Academy of Sciences of China's newly established research center for eco-environment sciences, said that the dirtiest industries such as paper maming and electroplating have been banned in cities, and other factories are moving to rural areas to take advantage of lax enforcement of pollution codes there.

Environmental protection agencies established in each of China's 324 cities since 1978 have been policing urban factories with good results, Wang said in an interview on the final day of a pacific environmental conference here.

Outdated technology and lack of strict enforcement of pollution laws in rural areas, however, are turning waterways into stinking, murky ditches, with dangerous heavy metal pollution tens to hundreds of times higher than normal criteria, Wang said.

Pollution is also affecting human health, he added.

Water pollution, the number one environmental problem in coastal areas, may be linked to the 20 percent higher cancer mortality rate for fishermen in Bohai bay compared with nearby farmers, the scientist from China's top environmental institute said.

Fishermen also have twice the level of mercury in their hair compared to farmers.

Air pollution may be related to an increase in lung cancer deaths from 17 people per 100,000 population in 1975 to 32 people per 100,000 citizens in 1984, he said. Meanwhile, the number of smog days in one area more than doubled from 88 days in 1982 to 199 days in 1984, he reported.

So far, acid rain--precipitation polluted by emissions generally from coal-burning plants that has been linked to damaged forests and lakes in North America and Europe--has been found locally in some southern cities.

In answer to a question raised at the conference concerning acid rain travelling from China and South Korea toward Japan, Wang said "the Chinese atmosphere could affect Japan because they share one ecosystem, so we should cooperate more with Japan on research."

Wang likened China's pollution problems to those of Japan 20 years ago. Limited financial resources and priorities on economic development will delay environmental improvements, but personnel training by other countries like Japan could expedite efforts, he said.

Wang said an increasing number of high-level officials are now paying lip service to environmental problems in reports and speeches. But widespread "ecological unconsciousness," short-term decision making, and low awareness about the environment among citizens means "there will be a long distance to go from the idea to reality," he added.

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CSO: 4008/2021

SCIENTISTS ACHIEVE BIO-ENGINEERING BREAKTHROUGH

OW210630 Beijing XINHUA in English 0532 GMT 21 Jul 87

[Text] Beijing, 21 Jul (XINHUA)--Chinese botanists in Beijing recently made a breakthrough in bio-engineering technology by successfully cultivating the world's first group of regenerated plants from kiwi fruit and maize, reported today's english newspaper CHINA DAILY.

The paper said that the research was carried out by scientists from the Institute of Botany under the Chinese Academy of Sciences, headed by Qian Yingqian, Cai Qigui and Guo Zhongzhen. The achievement opened up new ways to cultivate improved varieties of the two plants through bio-engineering.

Separating plants' protoplasts (cells without walls, or naked cells) from common cells is a new biotechnology developed in the last 20 years.

Ordinary plant cells, protected by walls of cellulose, are very hard to fuse with genetic materials from other plants such as genes or dna (deoxyribo-nucleic acid).

But naked cells can be fused with genetic materials from otherplants, creating new varieties of plants. The protoplast's separation has to be done in test tubes.

The plants grown from the protoplasts are known as regenerated plants. They are a kind of hybrid.

"In 1971, a Japanese virologist cultivated the world's first regenerated plant from a tobacco leaf," said Qian Yingqian, now director of the Bureau of Biosciences and Biotechnology of the Chinese Academy of Sciences.

"Since then scientists around the world have hoped to get the same thing from other crops, especially rice, maize and wheat."

It was not until 1985 that Japanese scientists succeeded in cultivating regenerated rice plants. Reports of success then came from France and China.

After rice, maize became the next challenge.

In 1977 Ingo Potrykus, a Swiss scientist, achieved some success. He obtained some calli--basic materials from separating naked cells--from a maize stem. But it took ten years for further progress.

Qian and his group started their research last November and within eight months had succeeded. "It takes four months to cultivate the maize seedlings from protoplasts," Qian said.

The green maize seedlings still growing in the test tubes will be moved into fields. This is considered a "critical step" by Qian and his colleagues.

Meanwhile, 50 kiwi fruit seedlings are growing well in the fields of Wuhan, capital of Hubei Province.

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CSO: 4008/2022

## TWO TYPES OF NON-CHOLINERGIC SLOW POSTSYNAPTIC POTENTIALS IN INFERIOR MESENTERIC GANGLION NEURONS OF RABBIT

Shanghai SHENLI XUEBAO [ACTA PHYSIOLOGICA SINICA] in Chinese Vol 38 No 6, 1986 pp 576-582

[English abstract of article by Jiang Zhigen [5592 1807 2704], et al., of the Cell Electrophysiology Laboratory, Wannan Medical College, Wuhu, Anhui]

[Text] With a bridge pre-amplifier, the transmembrane potential of the inferior mesenteric ganglion (IMG) cell of a rabbit was investigated by an intracellular recording technique. A short train of stimulation of the preganglionic nerves elicited a volley of fast excitatory postsynaptic potentials or orthodromic discharges which were followed, in the majority of cells, by a slow depolarization lasting for about 2 minutes. This slow potential was resistant to d-tubocurarine (d-TC) and atropine, and could be reversibly blocked by a low calcium (0.25 mM) and high magnesium (12 mM) Krebs solution. Consequently, the potential was termed non-cholinergic excitatory postsynaptic potential and could be categorized as a kind of late slow excitatory postsynaptic potential (ls-EPSP). The ls-EPSP in the majority of cells sampled was accompanied by an increase in membrane resistance and was attenuated upon conditioning hyperpolarization, which suggested that an inactivation of potassium conductance was probably involved in genesis of the slow potential. Superfusion of substance P caused no appreciable change in the ls-EPSP. In addition, some of the cells in the rabbit IMG generated a hyperpolarization potential after a train stimulation of the preganglionic fibers. The hyperpolarization lasted about 1 minute and was enhanced by conditioning hyperpolarization. It was also d-TC- and atropine-resistant, but sensitive to low calcium/high magnesium; therefore, it was termed "very slow inhibitory postsynaptic potential" (vs-IPSP) to be distinguished from s-IPSP, a conventional term for the slow cholinergic synaptic response in some autonomic neurones. The transmitters responsible for these two types of non-cholinergic synaptic potentials remain to be identified. (Paper received 11 Dec 85; finalized 31 Jan 86.)

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## MECHANISM OF INHIBITORY ACTION OF EPHEDRINE ON TWITCH RESPONSE OF MOUSE VAS DEFERENS TO FIELD STIMULATION

Shanghai SHENLI XUEBAO [ACTA PHYSIOLOGICA SINICA] in Chinese Vol 38 No 6, 1986 pp 583-588

[English abstract of article by Shu Huaide [2631 2037 1795], et al., of the Department of Pharmacology, Faculty of Basic Medical Sciences, Shanghai Medical University]

[Text] At a lower concentration range ( $10 \text{ nmol/L}^{-0.1} \text{ mmol/L}$ ), ephedrine could inhibit the twitch response of a mouse vas deferens to field stimulation in a concentration dependent manner. This inhibitory effect of ephedrine could be antagonized by yohimbine ( $0.1 \mu\text{mol/L}$ ). Noradrenaline ( $0.1 \text{ nmol/L}^{-10} \mu\text{mol/L}$ ) and tyramine ( $0.1 \mu\text{mol/L}^{-0.1} \text{ mmol/L}$ ) had similar actions as that of ephedrine, but phenylephrine did not. Depletion of the tissue stores of catecholamine with reserpine or the blockade of neuronal uptake by cocaine reduced the inhibitory effects of ephedrine and tyramine, while it sensitized the action of noradrenaline. These results indicate that the action of ephedrine on presynaptic  $\alpha_2$ -adrenoceptors was at least partially produced by the released noradrenaline. The fact that the action of ephedrine was significantly reduced or even abolished by high  $\text{Ca}^{++}$  and 4-aminopyridine suggests that the inhibitory action of ephedrine on the release of noradrenaline was possibly related to the blockade of the  $\text{Ca}^{++}$  influx. (Paper received 24 Dec 85; finalized 4 Feb 86)

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# RELATIONSHIP BETWEEN HEAR RATE AND EFFECTIVE REFRACTORY PERIOD OF VENTRICULAR CELLS OF RABBIT AT SINUS RHYTHM IN SITU

Shanghai SHENLI XUEBAO [ACTA PHYSIOLOGICA SINICA] in Chinese Vol 38 No 6, 1986 pp 610-618

[English abstract of article by Wang Qiang [3769 1730], et al., of the Department of Physiology, Tongji Medical University, Wuhan]

[Text] The effective refractory period (ERP) of left ventricular cells of 38 albino rabbits at various heart rates during natural breathing were determined. The phase 0 of the transmembrane action potential (TAP) that was recorded with a floating glass microelectrode was used to trigger the stimulating circuit. TAP was used as the indicator of excitation. Through statistical analysis of the data of 134 units, quantitative relationship between heart rate and ERP was evaluated when the sinus cycle lengths (RR interval) were in the range of 205-330 ms and a regression equation was obtained by linear regression. The correction formula that can eliminate the effect of heart rate on ERP was also worked out. Significant prolongation ( $P < 0.0001$ ) of (ERP) was induced by antimony potassium tartrate (APT, 50 mg/kg, i.v.) injected during sinus rhythm (7.8 percent) and when the cycle length was held constant at 260 ms by ventricular pacing (7.5 percent). The results of corrected ERP at sinus rhythm are constant with the results of pacing rhythm, indicating that the correction formula is very useful. The ratio ERP/RR interval was greater at shorter cycle lengths, indicating that a larger fraction of the cycle was refractory at faster heart rates. The ratios ERP/APD<sub>90</sub> and ERP/QT remain constant in the range of sinus cycle lengths studied. (Paper received 5 Aug 85; finalized 18 Dec 85.)

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# ROLE OF VENTRAL MEDULLARY AREA OF RABBITS IN INHIBITORY MECHANISM OF MORPHINE ON RESPIRATION

Shanghai SHENLI XUEBAO [ACTA PHYSIOLOGICA SINICA] in Chinese Vol 38 No 6, 1986 pp 627-634

[English abstract of article by Gong Qianling [7895 5409 3781], et al., of the Department of Physiology, Shanghai Medical University]

[Text] Experiments were performed on 36 anesthetized, immobilized and artificially ventilated rabbits. The role of the ventral portion of the medulla oblongata in the respiratory depression induced by morphine administration was studied. Morphine applied locally on the S area of the ventral surface of the medulla resulted in a depression of the phrenic nerve discharge which could be reversed by naloxone. Administration of sodium glutamate on the S area caused an activation of the phrenic discharge. Microinjection of morphine into the NPBm induced a respiratory inhibition that could be prevented by application of naloxone on the S area.

Most of the units recorded in the ventral medullary area could be inhibited by electrical stimulation of NPBm, and the majority of them could be depressed by microionophoretical application of morphine. The results obtained indicate that the ventral medullary area has neurons capable of activating phrenic nerve discharge which can be inhibited by microinjection of morphine into the NPBm via activation of the opiate receptors and in turn leading to inhibition of the phrenic nerve activity. (Paper received 5 Sep 85; finalized 15 Nov 85.)

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## BRIEFS

MEDICAL LASER DEVELOPED--Hangzhou, 25 July (XINHUA)--A new medical machine using a laser beam to treat cancer passed assessment here today. Doctors and experts assessing the equipment believed that the machine is effective in the treatment of certain cancers. China began to use lasers to treat cancer patients at the beginning of the 1980s and the research project for the new machine was listed in the state sixth and seventh 5-Year Plans (1980-1990). A doctor said previous laser equipment which was used widely, wears out easily, wastes water and electricity and is expensive. The new machine has none of the above defects, he said. It was jointly developed by the Department of Physics of Zhejiang University and the Zhejiang Research Institute of Medical Equipment after a two year effort. A professor from the department said that the machine emits green light to tell the location of the cancer and red light to treat the tumor both inside and on the surface of the patient. A doctor said that the machine had been experimentally used for seven months in the provincial cancer hospital before it went through the assessment. About 75 percent of the patient improved after the treatment. [Text] [Beijing XINHUA in English 0149 GMT 25 Jul 87 OW] /12913

HERBS IN TEST TUBES--Shanghai, 12 August (XINHUA)--Chinese scientists have succeeded in cultivating sprouts of traditional Chinese medicinal herbs in test tubes instead of planting seeds. After two years' research, Rui Hekai, deputy director of the Shanghai Traditional Chinese Medicine Research Institute, has cultivated 34 kinds of medicinal plants in test tubes, which were later transplanted into greenhouses or fields. Tests proved all the seedlings grew well. "Any part of the root, stalk or leaf can be cut from the plant and grafted into a special [word indistinct] the test tube after being sterilized," said Rui. "The new cultivation method will shorten the growing period and augment quality of plants and make the plant free from natural disorders," Rui added. Usually, it takes six years to grow a coptis root, a kind of medicine which clears up and removed "bad heat" in the human body. The new method will cut the growing period for the root, which is in short supply, to two months. [Text] [Beijing XINHUA in English 1349 GMT 12 Aug 87 OW] /12913

'PRODUCTION-PROMOTING' BACTERIA--A group of "production-promotion" bacteria that can accelerate plant growth, strengthen resistance to disease, drought, and cold and also greatly increase production and promote product quality, has been successfully screened from plants at the Beijing Agricultural

University by professor Chen Yanxi [7115 1693 3556]. Currently over 16 million mu of farmland have been tested with these bacteria, which the farmers call "miracle bacteria." These bacteria were obtained from bacteria from many kinds of plants; they have the property of inhibiting the growth of plant-destructive bacteria so as to attain the effect of increasing production. The application of "production-promoting" bacteria is easy to handle, inexpensive, and causes no pollution problems or other side effects. [Excerpt] [Beijing RENMIN RIBAO in Chinese 28 Jun 87 p 1]

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CSO: 4009/3029

STATE COUNCIL RECEIVES REPORT ON ENVIRONMENT

OW042007 Beijing XINHUA in English 1427 GMT 4 Jun 87

[Text] Beijing, 4 Jun (XINHUA)--The central government is calling for cities throughout the country to make greater endeavors to create a safe, clean, tranquil and beautiful environment.

The Ministry of Urban and Rural Construction and Environmental Protection recently submitted to the State Council a report which contains norms for urban environmental protection by 1990.

According to the report, each cubic meter of atmosphere must contain no more than 500 micrograms of dust in northern cities and 300 micrograms in southern cities.

To reduce air pollution, central heating systems must be promoted in northern cities, and in the meantime, solar energy and thermal energy be utilized to a greater extent.

The noise in main streets must not exceed 70 decibels during the daytime, the report says. The use of car horns is banned in downtown areas.

The green coverage for each resident shall reach four square meters on the average by 1990--greater in provincial capitals and scenic spots.

Scenic cities and sites of historic interest, including the Chinese capital, must attain a still better environment, it says.

The report also urges local authorities to make a scientific rearrangement of urban layouts to move out or close down the existing polluting factories near water sources, scenic spots and densely populated living quarters.

The report also urges improvement of sewage treatment, and means to protect water resources and save drinking water.

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CSO: 4008/2024

## NATIONAL DEVELOPMENTS

### NATIONAL SCIENCE, TECHNOLOGY DEVELOPMENT STRATEGY CHARTED

Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 13 Jul 87 p 2

[Article by Zhang Dengyi [1728 4098 5030]: "China's Science and Technology Development Strategy"]

[Text] The major goal of China's science and technology development strategy is for China's industrial and agricultural production technology to achieve by the year 2000 substantially the same general level attained by developed countries during the 1970's and 1980's, and to be able to approach the advanced world level of that time in certain high technology fields.

In order to realize this goal, China has decided on the following several science and technology strategy actions:

First is the adoption of new technology to hasten the technical transformation of traditional industries.

The technical transformation of traditional industries requires not only reliance primarily on research and development by domestic forces, but also the active introduction of advanced technology from abroad in order to gain time.

Second is the selective development of high technology in order to create and develop new industrial services.

The key to the development of China's development of high technology lies in biotechnology, information technology, new materials, automation technology, new energy technology, space technology, and laser technology. In addition, it is necessary to formulate specific goals and actions to be taken.

Third is energetic development and promotion of "short, level and speedy" technology that can be applied in an integrated way for the vigorous development of rural economic services.

By "short" is meant a short cycle of technological development; "level" means development of a technology that is consistent with the present level of economic development and the present level of management in China's rural villages; and by "speedy" is meant projects that show results and profits



quickly.

Fourth is energetic support for applied research and basic research that has profound and lasting effects on national economic development.

Inasmuch as research and development of China's production technology urgently requires strengthening while available investment for science and technology is limited, China can select only that basic research that holds major significance for the long-term development of the country's economy and production techniques, that plays a major role in exploitation of the country's strengths in resources, and for which a substantial foundation already exists for making breakthroughs within the near future.

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CSO:40083020

CAS SHANGHAI BRANCH TACKLING KEY PROJECTS IN SEVENTH 5-YEAR PLAN

Beijing KEJI RIBAO in Chinese 17 Apr 87 p 1

[Article: "Chinese Academy of Sciences Shanghai Branch Research Institutes Enthusiastically Participate in Tackling Key Projects During the Seventh 5-Year Plan; Organize Crack Technical Troops to Rush Into the Major Battlefields of Economic Construction"]

[Text] The research institutes of the Chinese Academy of Sciences Shanghai branch are bringing their multi-disciplinary, comprehensive superiority into full play, to enthusiastically tackle key projects of the Seventh 5-Year Plan. Preliminary statistics indicate that the 12 research institutes of the Shanghai branch are assuming responsibility for more than 140 national key projects in the Seventh 5-Year Plan.

The majority of the key technical projects taken on by the institutes have relatively large economic and social benefits. Some have considerable scholarly significance. In order to mobilize their principle S&T force and organize it for service on the major battlefields of economic construction, the institutes' leadership has already assumed responsibility for some key projects. Some examples are: the Biochemistry Institute's "development of a genetically engineered vaccine for the type B hepatitis antigen;" the Cell Biology Institute's "development of a genetically engineered growth hormone;" and the Metallurgy Institute's "bioengineering sensor and secondary meter." These key projects will take some years to complete, but it is expected that they will produce some results which are high level, strong in applicability, with obvious socio-economic benefits.

A project titled "Research and Development of an Erasable Impact Writing Light Plate System," from the Metallurgy Institute and the Optics and Fine Mechanics Institute, currently has the most attractive optical storage technology. It has such characteristics and a high notation density. It can repeatedly carry out notations and can erase. However, it has a fairly involved degree of difficulty technologically. This project is under the direction of Gan Fuxi [1626 4395 3588], member of the CAS Scientific Council and noted expert on optical materials. After more than a year's effort, there has been some definite progress made in development.

The Shanghai Plant Physiology Institute has amassed a substantial amount of research data on such matters as the photosynthetic effect, nitrogen, microbiological research, etc. During the period of the Seventh 5-Year Plan, a large group of highly capable personnel will assume responsibility for key bio-engineering topics relating to such matters as protein storage, optical effect genetics, nitrogen genetics, protein and genetic control of insect poisons, etc. This research will lead to increasing the resistance of crops to disease and pests, raising high-yield, top-grade strains, and bring benefits to mankind.

12625/7358

CSO: 4008/54

SHANGHAI'S 15-YEAR MEDICAL RESEARCH PLAN OUTLINED

Shanghai WEN HUI BAO in Chinese 16 Jun 87 p 1

[Article by Mao Hanwen [3029 3352 2429]: "City Medical Bodies Formulate 15-Year Scientific Research Plans. Malignant Tumors One of 11 Key Topics To Be Tackled"]

[Text] More than 100 medical experts in the city are in process of working up strategic research to develop Shanghai's medical science and technology. Malignant tumors and cardiovascular diseases are to be among 11 medical topics on which scientific research in the city will be focused during the next 15 years.

In the selection of these scientific research projects, the emphasis has been on those diseases that most seriously impair people's health, on the medical fields in which Shanghai is paramount, and on medical topics related to the functioning of a large industrial city. These include malignant tumors, cardiovascular diseases, viral hepatitis, labor hygiene and occupational diseases, planned parenthood and eugenics among a total of 11 topics. Following a large amount of survey work and repeated authentication, experts have set these topics as combat goals and strategic tasks. Work on viral hepatitis during the next 15 years will focus on vaccination for the prevention of hepatitis B and on research on high quality testing reagents. Work on malignant tumors will focus on the liver, lungs, stomach, and intestines, with an intensification of basic research and epidemiological investigation. The emphasis in cardiovascular disease work will be on the prevention and treatment of coronary heart disease, high blood pressure, and strokes. In addition, emphasis will be given to research on heart valve disease, congenital heart disease, and viral myocarditis.

Forecasts call for the city to continue, as a result of efforts, to maintain a leading international standard in microsurgery and in burns by the year 2000. In the diagnosis of viral hepatitis and coronary heart disease, in surgery to replace heart valves and for congenital heart disease, in the epidemiology of tumors, in the treatment of liver cancers and certain immunopathic diseases, and in the transplantation of organs, the city will be close to or will reach current advanced international standards. Its basic research and its nuclear medicine should reach the advanced international standards of the late 1980's or the early 1990's. Thus, Shanghai will gradually become a city with a singularly modern medical scientific and technical system.

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CSO:40083020

SCIENTIFIC MANAGEMENT OF STRATEGIC MISSILE UNITS UNDERTAKEN

Beijing KEJI RIBAO in Chinese 19 Apr 87 p 1

[Article by Zhang Yuying [1728 3768 3853] and Zhang Jiajun [1728 1367 6511]: "Rear Services Strategic Missile Units Managed Scientifically; In Just Over One Year More Than 240 Research Projects Accomplished"]

[Text] Applying S&T to the rear services strategic missile units has been praised as a "belated first step, but with fast results" by the General Logistics Department. From January of last year to this past 10 April there have been new results in more than 240 research projects. These have been in such areas as equipment research, automated command of rear services management, frontline living safety, nuclear sanitation protection, control of the environment, etc.

Rear services strategic missile units were organized 20 years ago, and all along have filled an urgent need. But little attention has been paid to the work of these units, especially to the needs of modernizing them. In order to change the backward situation of these units as rapidly as possible, the General Logistics Department and the strategic missile units have extensively developed activities to further the building of a modernized rear services through research. Within a year, results were achieved in more than 100 major projects alone, resolving the units' long-time status of being an "old disaster," the first step in altering its backward image. Rear services strategic missile units are a particular source of pollution, presenting a major health and environmental hazard. Because the rear services equipment was so dated, there has been no way to bring this under control. They successfully developed equipment for the treatment of propellant waste liquid, the first domestic instance of a vehicle-mounted, high-efficiency turbine, ozone treatment of propellant waste. This brought the original situation totally under control. There used to be from 50 to 177 mg of hazardous propellant waste per litre, but now this has been eliminated as a threat to humans or to the environment. After the radioactive waste treatment equipment has removed the radioactive waste matter from nuclear warheads in storage, the waste matter content is far lower than the concentration limit for open-air water sources, allowing discharge directly into natural bodies of water. These two achievements filled a gap in this country, and reached the international advanced level.

They are countering the situation where strategic missile units come into contact with many hazardous materials. Besides making important breakthroughs, in theoretical research on nuclear safety, they have developed complete safety equipment for dealing with nuclear accidents, filling a gap in rear services installations. Their successes are quite obvious in research into the units' farming at their stations. Formerly, strategic missile units lacked any special operating clothing; the units were garrisoned in tunnels with no safeguards for their food and drink; and there were no facilities for disposal of human waste, increasing the radon hazards to humans in the tunnels. In only half a year's drills, there were a large number of injuries among officers and men. This was approached as an urgent matter by the General Logistics Department and an emergency team of technical personnel from the units themselves. Speeding up the intensity of their research, within a year they developed work clothing and acid-resistant clothing appropriate to deal with the conditions of low-temperatures and intense summer heat which characterize these regions; cooking utensils for preparing food and drink in the tunnels; human waste treatment facilities for the tunnels; a shielding method for lowering radon, etc. After these had been tried in the units, and their obvious effectiveness brought into full use, they were deeply welcomed by the officers and men.

The strategic missile units have achieved initial results in the area of command management apparatus and equipment. This completes the microcomputer network for rear services organizations and the microcomputer management of tertiary rear services organizations. They have developed and are popularizing a batch of software for application in rear services units. They have created an automated management system for storehouses. They have achieved numerous successes in such areas as transport vehicles, armaments and engineering machinery, altering and independently developing more than 300 pieces of machinery of over 50 types. This has raised the efficiency rate.

12625/7358

CSO: 4008/54

CONTROL SYSTEMS FOR RACK-TESTING ENGINES

Shanghai ZIDONGHUA YIBIAO [PROCESS AUTOMATION INSTRUMENTATION] in Chinese  
Vol 7 No 5, 20 May 86 pp 5-10, 46

[Article by Wang Jiong [3769 3518] of the Tianjin City Industrial Automation Instrumentation Research Institute: "Control Systems for Rack-Testing Engines and Their Development"]

[Excerpts] As the automobile industry has developed and the number of vehicles being produced has grown, engine testing has become an important part of the automobile industry. It is used not only for determination and evaluation of design performance, manufacturing quality, reliability of use and other aspects, but also is closely related to research on engines and their components, product improvement, technological updating and other areas. Engine research and testing has become an independent scientific and technical sector. Many automobile and engine production plants have established special engine testing laboratories and are working to study and develop control systems for rack-testing engines. This article will provide an overall introduction to the situation in control systems for rack-testing of engines in China and in foreign countries.

I. An Overview of Control Systems for Rack-Testing Engines

II. An Introduction to Typical Control Systems for Rack-Testing Engines in China and Foreign Countries

Control systems for rack-testing of engines have developed very quickly in foreign countries in recent years. This is especially true regarding the use of microcomputers, which has led to substantial improvements in control systems for rack-testing. Typical plants include Meidensha and Ono in Japan, Schenck in West Germany, VEM in East Germany and others.

China began developing [such systems] at the end of the 1970's and put them into use during the early 1980's. Because of restrictions brought about by actual conditions, these control systems were not utilized in an ideal fashion and there are certain discrepancies compared with foreign countries.

Below, an introduction to typical control systems for rack-testing in China and foreign countries will be provided.

#### 4. An introduction to typical control systems for rack-testing of engines in China

Since the late 1970's, some institutions of higher education, scientific research units and industrial enterprises in China have developed various types of control systems for rack-testing of engines. Compared with the three typical systems mentioned above, these control systems exhibit certain differences in control functions, primarily in technical indices, reliability and other areas. Some have been abandoned by users while others are reluctantly being utilized, and it is very difficult to produce them in large amounts and put them into widespread use. Advances in microcomputer technologies in recent years have led to new growth in the development of control systems for rack-testing of engines, and new control systems are being put into use in China. Below, the SFT-1 engine process control testing equipment that was successfully developed in 1981 will be described.

SFT-1 engine process testing equipment is composed of control systems for rotating speed, load control systems, 10-step process setters, fuel consumption gauges, inspection systems and protection systems. They also can be combined with hydraulic dynamometers as well as electrical eddy-current dynamometers. Rotating speed control systems involve analog quantity input closed-loop control systems (Figure 4) that compare given values of rotation speed with the actual values, which after amplification control actuators to change the degree to which the throttle is opened until they attain the required rotating speed.

Load control systems also are a closed-loop control system. They are different from rotating speed control systems in that they employ pulse regulation configurations to solve problems with hydraulic dynamometer hysteresis. When the regulated amount exceeds the full load by 10 percent, the actuators regulate hydraulic valves at full speed, which is constant rate regulation; when the amount of regulation is 10 percent less than full load, pulse regulation comes into play.

The 10-speed process setters set the values (achieved through several potentiometers) for working conditions (rotating speed and load). The time of operation under each step of the working conditions is set by two-place dial-up switches at 00 to 99 (in units of seconds, minutes or 10 seconds). Secondary settings (0 to 9) in a small cycle also are found within the larger cycle.

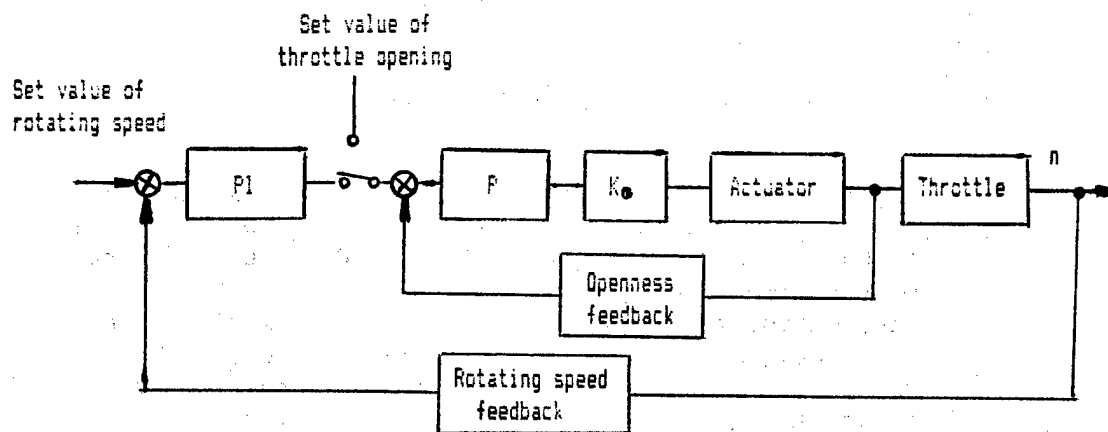
Numerical processing systems operate using HD38401 integrated circuits. Operational control is achieved using fixed processes.\* The operational parameters are rotating speed (n), load (p), fuel (G), fuel consumption

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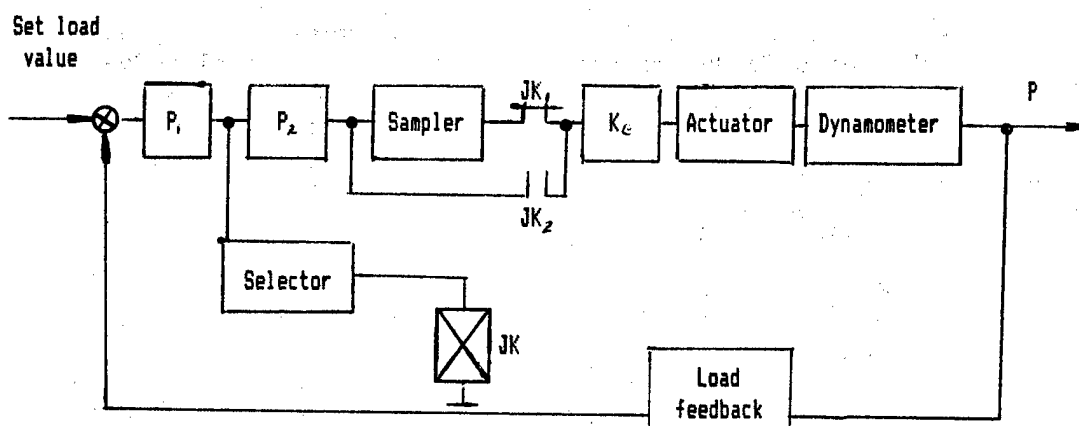
\* Author's note: The adoption of the HD38401 as an operational controller was feasible at the time but now is considered backward.



Figure 4. [Outline of China's SFT-1 Engine Process Testing Equipment]



(a) Rotating speed control system



(b) Load control system

time ( $t$ ), volume of air ( $V$ ) and air density ( $B$ ). The operational results are power ( $N$ ), torque ( $M$ ), hourly fuel consumption ( $G$ ), fuel consumption ( $GE$ ) and air-fuel ratio ( $R$ ). Operational conditions are given to five places with two places after the decimal.

Inspection systems are designed to monitor all engine parameters. They are composed of scanners, frequency dividers, control logic and A/D converters, and they have periodic inspections, automatic printing (process control, time setting and summoners) and reconnaissance display

functions. There are 40 analog input circuits and two specialized P and V converter inputs. Scale conversions can eliminate 2, 3, 4, 5, 6, and 8 for selection. The output is BCD [binary coded decimal] to five places.

Accident alarms and automatic runaway protection systems are an important part of this equipment. The accident alarm items are: (1) high exhaust temperature; (2) high oil temperature; (3) high water temperature; (4) low oil pressure; (5) high oil pressure; (6) low water pressure (dynamometer cooling water); (7) high crankcase waste gas pressure; (8) hyperspeed [chaodu 6389 1653]; (9) runaway and (10) inadequate "ring oil." When any of the above accidents occur, besides sound and light alarms, there also are indicator lights to indicate the various accident items. Automatic runaway protection mainly involves cutoff of spark sources in gasoline engines. If runaway occurs in a diesel engine, load is first maintained unchanged and the throttle is shut as quickly as possible until the rotating speed reaches 1,000 rpm (which is the idling speed state), after which the load is reduced to zero.

### III. Some Viewpoints

1. The rapid development of the automobile industry and all types of vehicles (engineering machinery, farm machinery and so on) and the continual intensification of energy conservation work will promote even greater developments in control systems for rack-testing of engines. The fact that China's control systems for rack-testing of engines are in the development stage presents the automation industry with urgent topics in developing highly automated, reliably-performing control systems for rack-testing as well as the corresponding monitoring instruments (ignition advance angle testers, specialized regulators, air flowmeters, rapid operating mechanisms and so on). This means that there are considerable market prospects for rack-testing control systems.
2. The trend in development of control systems for rack-testing of engines during the 1980's is toward microcomputerization. Computers are used not only for data processing but also can replace analog closed-ring regulation systems to achieve numerical control (of rotating speed and torque). Keyboards and screen displays can replace enormous display instruments and operating buttons on operating platforms. Process control software is easy to revise and replace. Plotters can be used for direct plotting of test curves, which will greatly facilitate testing work.
3. Attention should be paid not just to control systems but also to the development of the matching monitoring instruments. The organization and function of control systems can be accommodated flexibly to users' requirements, and inspection and monitoring instruments are developing toward miniaturization and high precision.
4. Computer applications have led to a tendency toward multi-rack centralized management in rack control. The terminus of each rack is a single board that uses a complete computer with sufficient capacity and functions as a central processor for centralized management and control. This aids in decreasing investments and is quite suited to the needs of laboratories in industrial enterprises.

AERONAUTICAL MEDICAL SCIENCE DEVELOPED FOR PILOTS

OW081703 Beijing XINHUA in English 1441 GMT 8 Jul 87

[Text] Beijing, 8 Jul (XINHUA)--China has established a system of aeronautical medical science providing regular health check-ups, physical training and rehabilitation services for pilots while producing special foods and articles that suit the physical conditions of China's pilots.

Research personnel in this field have also worked out the standard categories of pilots' physical structures and bodily forms so that China can design aircraft more suitable for the pilots.

This was learned at the inauguration meeting of the China Aeronautical Medical Science Society here today.

Li Zhigang, director of the Public Health Department of the Air Force of the Chinese People's Liberation Army (PLA), was elected president of the society. Noted aeronautical physiologist Cai Qiao was elected honorary president of the society.

Zhang Aiping, deputy secretary general of the Central Military Commission and minister of national defense, wrote the calligraphy for the society's name-plate.

More than 5,000 aeronautical medical personnel throughout the country provide round-the-clock health service for pilots of a-1 types of aircraft, the society president told XINHUA.

Scientific research findings in more than 30 items of the aeronautical medical science have received national awards. Some of China's scientific research findings such as the function of auditory tubes and the prevention and treatment of aeronautical otitis have won world-wide reputations, the director said.

Li expressed the hope that his society would conduct more academic exchanges with its counterparts overseas to contribute to the development of the science.

The society was jointly sponsored by the PLA Air Force and Navy, the Ministry of the Aeronautics Industry, and other military and government institutions at the central level.

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CSO: 4008/2024

## NATIONAL DEVELOPMENTS

### MILITARY MEDICAL ACADEMY AIDS IN NUTRITION, WOUND TREATMENT

Beijing RENMIN RIBAO [PEOPLE'S DAILY] in Chinese 10 Jul 87 p 8

[Article by Special Correspondent Hong Mao [3163 4243] and Correspondent Tang Shifen [0781 1102 5358]: "Completion of 10 Scientific Research Achievements By Nutritional Sanitation Research Laboratory of Military Academy of Medical Sciences. Strengthening of Survival Capabilities of Troops In The Field and Assuring Health of Officers and Men"]

[Text] Scientific research personnel in the Nutritional Sanitation Research Laboratory of the Institute of Hygiene and Environmental Medicine of the Military Academy of Medical Sciences have consistently given priority to assuring the good health of the officers and men in the country's armed forces, and to improving the health of officers and men and their ability to survive in the field. They have now completed 10 scientific research achievements, one of which fills a national gap, and two of which are at an advanced world level.

For the past 30 years, this laboratory has drawn up and revised nutritional standards for every service and branch of service in the nation's armed forces, developing long-lasting vitamin B<sub>1</sub> injections, long lasting riboflavin, vitamin C phosphoric esterase, and vitamin A to D emulsions. The laboratory has compiled the first nationwide compendium of edible wild herbs, and has developed both compound amino acid injections to provide additional protein for burn victims and essential food nutrient preparations to restore victims to health. It has additionally designed diets for the treatment of high blood lipids for airborne troops.

During battle, numerous unexpected situations may arise at any time such as being cut off from military rations and vegetables. If troops are able to suit general methods to specific circumstances during such times, making full use of edible wild herbs that provide more nutrition than common vegetables, they will be able to maintain their strength and escape a predicament. The research personnel in the nutritional sanitation research laboratory conducted a long survey so that soldiers could quickly distinguish those edible wild herbs with a high nutritional content and no toxic side effects. In 1965, the laboratory completed a compendium of tropical and sub-tropical edible wild herbs, which was printed and issued to every military company in the southwestern part of

the country. In 1983, researcher Zhou Deqin [0719 1795 0530] headed a taskforce that selected for survey 36 places throughout the country deemed representative in terms of geographical and climatic conditions and plant cover patterns. All year long, they roamed the wilds, going out early and returning late each day to conduct surveys among the people, to make notes on the ecological environment, and to analyze wild specimens. Within 3 years, this taskforce of only seven people traveled nearly 10,000 kilometers on foot to collect more than 300 different species of edible wild herbs found over a wide area, that grow in profusion, and that are rich in nourishment for the preliminary charting of the distribution and characteristics of the country's wild edible herb resources. They used this work as a basis for screening out 100 common kinds of edible wild herbs including such things as field thistle, which grows on the edges of deserts and is very high in nutrients, and lachang [5198 5214] tree flowers, whose vitamin C content is many times greater than that of common vegetables. In 1985, China's first national compendium of edible wild herbs was completed by this laboratory.

Riboflavin is a nutrient that maintains man's regular physiological activities. However, since it is water soluble, it is not retained for long by the human body. In order to solve this problem, the research personnel from this laboratory compounded more than 100 different kinds of riboflavin derivatives from which they selected lauric acid for the successful development of a long lasting riboflavin oil injection. Following such an injection, one will not suffer from a riboflavin deficiency even without eating no fresh vegetables for 3 months. It is 91.8 percent effective, surpassing the 6 week effectiveness period reported in American published references.

Patients with combat wounds, particularly seriously burned patients, lose very large amounts of protein, and large amounts of protein are required for the healing of wounds. Treatment of such patients requires emergency supplements of various amino acids to enable their bodies to synthesize protein. In 1974, under

leadership of Professor Gu Jingfan [7357 2529 5400], the laboratory's incumbent director and deputy director of the National Nutrition Society, the laboratory shouldered the task of compounding injectionable amino acids. At that time, amino acid research in China was in its infancy, and a complete line of amino acids could not be produced. They worked round the clock and in 1978 they developed and compounded six different amino acids to fill a national gap. They then surmounted still other difficulties, finally producing a combined injection containing 17 different amino acids in 1984, solving a difficult problem for burn victims.

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INSTITUTE FOCUSES ON APPLICATION OF MEDICAL RESEARCH

Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 11 Jul 87 p 1

[Article by Correspondent Tang Shifen [0781 1102 5358] and Central People's Broadcasting Station Correspondent Cui Qiang [1508 1730]: "Institute of Hygiene and Environmental Medicine of Military Academy of Medical Sciences Focuses on Applications in Pursuing Scientific Research. Thirty Years Is Like Just a Day in Serving the Armed Forces and Civilian Life"]

[Text] During the 30 years since its founding, the Institute of Hygiene and Environmental Medicine of the Military Academy of Medical Sciences has consistently focused on applications in pursuing scientific research, solving a series of problems in urgent need of solution in the building of both the armed forces and the civilian economy. Eighty-two of the 111 scientific research achievements the institute has completed are now in use throughout the armed forces. In addition, they have turned over 37 achievements to 35 civilian industrial plants, thereby enabling some of the plants' products to enter international markets. During the past 3 years, they have also provided 38 scientific research achievements to units such as the South Pole Study Team to insure smooth completion of South Pole study and external assistance projects.

In order for scientific research work to better serve the armed forces, this research institute's research personnel have oriented their work toward the grassroots, have delved into the realities of life, and have persevered in gaining an understanding of difficult problems and weak links in the building of the armed forces as a basis for selecting and deciding on scientific research topics to be pursued. Statistics show that 245 of the 270 activities currently underway originated in the armed forces. During training, artillerymen's ears are prone to deafness, so they developed ear plugs to protect against noise with the result that the number of artillerymen with hearing impairment dropped 89 percent. In order to safeguard the motherland's borders, they conducted research on acute high mountain reactions that provided a number of protective measures to be taken to guard against them. The Chinese-manufactured first generation temperature regulating heat producing bag, heat producing shoe insoles, and heat producing gloves that they developed can keep the hands, feet, and exposed portions of the body at a temperature of more than 26 degrees centigrade in bitter cold of 35 degrees below zero centigrade for between 5 to 48 hours, thereby solving the problem

of troop units in frigid zones of guarding against cold and preventing frostbite.

In addition, this institute made the most of its own strengths to expand the social and economic benefits of its scientific research achievements by striving to develop products useful in both military and civilian life. Since 1981, this institute has turned over 37 scientific and technical achievements to 35 industrial plants in nine provinces, cities, and autonomous regions including Tianjin, Hubei and Ningxia. After turning over the temperature regulating heat producing bag to the Tianjin No 8 Medical Equipment Plant, this plant got out of the loss situation it had been in for a long time, its profits for the year amounting to more than 100,000 yuan, and its products selling in distant Japanese and southeast Asian markets. After turning over its "oligosaccharide" research achievement to Jinghai County in Tianjin, the county entered the ranks of the national "spark plan" [whereby it is hoped that the "sparks" of advanced technology will gradually set a "fire of modernization."] In November 1984, this institute provided 15 scientific research achievements to China's first South Pole Study Team, making a contribution to assuring the team members' health and the smooth completion of the study mission. In the course of the team's journey across the oceans, medicine for the prevention of motion sickness decreased the seasickness reaction of numerous personnel, and sunburn lotion kept the skin of expedition members from being burned by the intense rays of the tropical sun. Engine room troops inserted ear plugs to protect against noise; expedition members suffering from heatstroke used chemical ice bags; and when freshwater was lacking aboard ship, skin cleansing lotions solved expedition members' bathing problem. During bitterly cold days, chemical heat producing bags protected expedition members against the cold and eliminated pains in the small of the back and in the legs incurred in the course of building the station. In 1985, they provided a joint Sino-Japanese mountain climbing team with 11 research results including compound medicine No 4 and refuling [3583 2421 7227]. In 1986, they provided eight research results including long-lasting vitamin B-2 to engineering personnel from the State Geological Prospecting Company sent to Peru. In March 1987, when a large explosion accident at the Harbin Yama Textile Plant occurred, they provided emergency assistance in the form of 2,400 bags of "essential foods" for the rescue of the injured to solve a pressing need of the Harbin Municipal Rescue Center.

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MAJOR BREAKTHROUGH IN ELECTRICAL CONDUCTION RESEARCH REPORTED

Use in Batteries

Beijing KEJI RIBAO in Chinese 20 Apr 87 p 1

[Article by Kuang Yongcheng [0562 3057 2052] and Guo Li [6753 5461]: "China Achieves a Major Breakthrough in Research on Electrical Conduction; Mu Shaolin Successfully Develops New Type Conducting High-Polymer Polyphenylamine to Replace Storage Battery Cathodes; in Over 100 Tests Performance Was Stable and Operation Reliable, So It Will Be Put Into Production"]

[Text] China has achieved a major breakthrough in electrical conduction high-polymer research. A battery which has electrodes constructed from polyphenylamine, a new polymer material, has been developed in Yangzhou, Jiangsu. This new material is a replacement for metals. China's leading experts regard this accomplishment as not only a pioneer effort in this country, but in a front-rank position internationally. Its level puts it at the initial stages of entering true practical application, with vast prospects. Plastic batteries could be brought out in the near future.

Electrical conduction high-polymer materials are basically a class of high-polymer plastics which become highly conductive materials when doped with certain types of ions. This phenomenon, that some types of high-polymers can have the same conductivity as metals, was discovered about 10 years ago by the American professor Mike Poami [phonetic]. However, until now there has not been a breakthrough development in worldwide research into practical applications. Mu Shaolin [4476 4801 2651], a middle-aged Chinese professor at Yangzhou Normal College, labored arduously on this for over three years. Under the guidance of the famous Chinese high-polymer physical chemist Professor Qian Renyuan [6929 0086 0037], he developed a new type of conducting high polymer, polyphenylamine, and used it successfully as a replacement electrode in a storage battery. In 1,241 charging and discharging tests, its performance was stable and its operation reliable, so it will go into production.

At a press conference held during the conference to evaluate this development, Professor Qian Renyuan, internationally renowned physical chemist and Member of the Chinese Academy of Sciences Scientific Council, told reporters that worldwide research into conducting polymers had only a 10 year history.



Research on its theory and practical application is still in the investigative stage. China's success in using the high-polymer polyphenylamine as a replacement for metal cathodes is a breakthrough of great significance. This new type of conducting plastic when used for electrodes has the following characteristics: it is light in weight, non-corrosive, can be used over and over again for charging and discharging, and is inexpensive. It has vast prospects for application, and is paving the way for China to open up its research into the development of high-polymer technology.

#### Substitute for Metal Electrodes

Beijing KEJI RIBAO in Chinese 20 Apr 87 p 1

[Article by Qian Renyuan [6929 0086 0337]: "A Simple Discussion of High-Polymer Materials"]

[Text] Usually, all high-polymer materials are insulators. But over the last 10 years, scientists have used negative and positive ions in such high-polymer materials as polyacetylene, polypyrrole, polythiophene, polypara-phenylenimine and polyphenylamine to bring the electrical conductivity of these materials to something near that of metals. This discovery has attracted the attention and interest of the chemistry and physics communities.

Conducting high-polymer materials are characterized by such advantages as being light in weight, non-corrosive and inexpensive. They have many uses. Today they are used chiefly in making materials for current electrodes, as a replacement for the usual metal electrodes. In the course of its electrode reaction, this type of electrode does not have a chemical reaction, does not dissolve, or leave a surface deposit. In the process of electric charge transfer and ion embedding, these characteristics can be most important for storage batteries.

A conduction high-polymer material's conductivity can be used to form an anti-static electricity composite plastic, and also has such properties as discoloration and absorption of electromagnetic waves, etc. These characteristics can be utilized to make indicators and installations for blocking electromagnetic wave interference.

Conduction in metals and semiconductors is the result of electrons or holes conducting current. How can high-polymers conduct electricity? Like a strong magnet, this has attracted the round-the-clock thought and work of a great many theoretical physicists.

Obtaining these results which approach truly practical applications makes it clear that in the realm of research on new materials for electrical conduction high-polymers, China has attained the international standard for the same category of research. This is an important breakthrough, and paves the way for China's development of electrical conduction high-polymer technology.

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CSO: 4008/54

MINING CONFERENCE FOCUSES ON NEW TECHNOLOGIES

Dalian KUANGSHAN JISHU [MINING TECHNOLOGY] in Chinese No 6, Nov 86 pp 1-2

[Article by Du Qifu [2629 0796 4395], China Metals Society: "Review and Prospects of National Mining Technology Conference; Celebrating the Convening of the Second National Mining Technology Conference"]

[Excerpts] The Second National Mining Technology Conference, which is the focus of attention in mining circles, is about to be convened under the leadership and attention of the China Science Society.

Reviewing the First National Mining Technology Conference held by the China Metals Society in October 1983 on the theme "Present State and Development of China's Mining Engineering", at which advanced technology and experience was exchanged and focus placed on major problems in the development of the mining industry, ways to resolve contradictions and specific measures based on policy and scientific and technical progress were discussed. The conference presented "Proposals to Accelerate Development of the Mining Industry" to the central authorities. Facts prove that scientific and technical conferences like this which cut across departments in the same industry play a role in expanding the field of vision, learning from each other and advancing together. It was beneficial for promoting the development and improvement of technical standards of Chinese mine production and earned good social and economic benefits. In the past 3 years, mining S&T has developed rapidly and in applied advanced technology, encouraging progress has been made in applying new scientific and technological achievements in mine engineering technology. China can manufacture the equipment needed for mines with annual production of millions of tons and this has played a part in mine production. In the area of mining policy, the country has improved appropriately the pricing of mining products and supplied mine weijianfei [4850 4675 6316] according to output and increased the vitality of mine production growth. In March of 1986 the state promulgated the Mine Production Resource Law and these measures have played a positive role in the development of mining.

The Second National Mining Technology Conference, which is about to be convened, will focus on the topic "Application of New Technology, New Methods, and New Materials in Mine Engineering" and will discuss the prospects of China's mining and major scientific and technological policy questions in mine engineering. This has far-reaching significance for the Seventh Five-Year Plan period and for mining science and technology and production.

During the Sixth Five-Year Plan, China's energy and communications and transportation shortages became one of the important factors restricting national economic development. Because of the serious attention of the party and state, a strategy for developing the energy and communications and transportation industries was formulated and forceful countermeasures were adopted which mitigated the contradictions in these areas. However, because of slow development of the raw materials and materials industries (including iron and steel, non-ferrous metals, chemical industry raw materials and construction materials) the contradiction of product supply and demand has become sharper day by day. The insufficiency of materials has become as acute as the energy shortage and is mutually restricting and influencing and in certain areas has aggravated the contradiction of the energy shortage. The primary issue in the shortage of materials is the backwardness of mine production which cannot catch up with the demands of processing capabilities. In the shortage of materials in China, the shortage of iron and steel is in first place. In the production of iron and steel materials, there is also a shortage in the supply of ore and there is no way to satisfy the demands of growth of refining processing capability thus holding back increases in iron and steel output. The key to the shortage of iron and steel materials is the shortage of ore. Obviously, mining occupies an important place in the national economy. In terms of the significance of this area, mining circles shoulder a heavy burden and are duty-bound. We should recognize this point profoundly and fully.

During the Seventh Five--Year Plan, the production of China's iron and steel industry will grow more. By 1990 China's steel output will be over 58 million tons; by the end of this century it should be over 80 million tons, or even more than 100 million tons. The arduous task borne by metallurgical mines with regard to mined raw materials products supplied to iron and steel mills in terms of current production capacity of 130 million tons annually far from satisfied the demand of the iron and steel industry. Thus, in addition to domestically mined ore, we will have to spend a great deal of foreign exchange to import ore, but if we can produce more or we can reduce imports and save foreign exchange. Hence, from now on we should vigorously develop iron mine production both to make up the annual 3 million ton shortfall in productive capacity of mine output as well as add new productive capacity. Metallurgical mines bear an enormous task with regard to the iron and steel industry.

From now on, metallurgical mines should both make up the shortfall in production capacity and add new production capacity; should both improve existing production mine to increase productive capacity as well as open new mines and carry on capital construction to expand production capacity. The arduousness of the task is incomparable to any period in the past. Thus, in addition to the state adopting relevant policy measures to vigorously promote mining, in

production and capital construction, it must adopt advanced technology to be able to bring about greater expansion of mining.

The Second National Mining Technology Conference, convened in the first year of the Seventh Five-Year Plan and facing a situation in which the state must vigorously develop mining product production, has a more important and far-reaching significance than in the past. The conference will exchange the latest fruits of mining science and technology, discuss the prospects and future of the development of China's mining, present proposals for important technological countermeasures for the development of China's mining. I hope that the representatives of China's mining circles who have taken on the task of promoting mining will learn from each other and progress together to spur on the technological advance of China's mining science and technology and make a greater contribution to the development and progress of the country's mines.

I wish the conference complete success.

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PROGRESS, PROSPECTS FOR LOW-ALLOY STEEL PRODUCTION

Beijing GANGTIE [IRON AND STEEL] in Chinese Vol 22 No 6, Jun 87 pp 1-3

[Article by Liu Jiahe [0491 0857 4421] of the Central Iron and Steel Research Institute: "Progress in Low-Alloy Steel Production in China During the Sixth 5-Year Plan and Prospects for the Seventh 5-Year Plan"]

[Text] China has made very substantial progress in low-alloy steel production and scientific research since the decision to treat the development of low-alloy steel and alloy steel as an important technical policy in the metallurgical industry. Output has doubled, product mix have become more rational, the range of applications is growing gradually and there have been obvious improvements in economic results. This is especially true of production technology and scientific research, which have leapt to new levels.

Output of low-alloy steel in China was three million tons in 1980 but had surged to six million tons by 1985, and it now accounts for 12.8 percent of total steel production. Output of low-alloy steel bars is up 115 percent, high-strength low-alloy structural steel is up 65 percent, high-strength, wear-resistant low-alloy heavy track is up 70 percent, low-alloy light track is up 600 percent, atmospheric corrosion-resistant low-alloy steel is up 300 percent and low-alloy mining steel is up 130 percent. The proportion of the various types of low-alloy steel in 1985 were: low-alloy steel bars, 43.5 percent; high-strength low-alloy structural steel, 30 percent; wear-resistant low-alloy steel, 14.4 percent; low-alloy mining steel, 2.3 percent; low-alloy light track, 3 percent; and others, 6.8 percent. These were not major changes compared with 1980. Of the larger enterprises, Angang produced the greatest amount, rising from 900,000 tons in 1980 to 1.46 million tons in 1985. Output in Shanghai's steel mills rose from 520,000 tons to 790,000 tons, and output at the Pangang and Shougang mills rose from 200,000 to more than 500,000 tons. Medium and small scale enterprises developed especially fast, with output surging from 420,000 tons in 1980 to 1.33 million tons in 1985, and they now account for 22 percent of total low-alloy steel production in China. The proportion of low-alloy steel smelted in oxygen conversion furnaces rose from 39 percent to more than 50 percent. The amount of steel processed via sprayed steel wrapping increased from 60,000 tons to more than 300,000 tons. Output of steel using controlled rolling or post-rolling rapid cooling surpassed 300,000 tons. Although there was a reduction in the number of types of

new steel products developed compared with past periods, there have been major improvements in varieties of steel and in products which could not be produced in the past and which were urgently needed within China. An example is 09 CuPt1 RE atmospheric corrosion-resistant steel developed in China. Used in the production of hot-rolled and cold-rolled steel plate and irregular-shaped vehicular steel, its dimensional specifications have been matched up and more than 1,500 railroad freight cars have been produced. Imitation Corten A steel also is being tested in several tens of railway passenger cars, and it has created the conditions for extending the useful life of railway cars. A production line with an annual capacity of 10,000 tons of 1300/1500 strength pre-stressed steel wire used in railroad ties has been completed and it has manufactured more than two million ties. Bracing steel used in intensified coal extraction has formed a series from 18 U, 25 U and 29 U to 36 U and has expanded shaft cross-sections from 12 to 16 square meters. The breaking load strength of coal conveyor pull chains increased from 41 tons to 51 tons following successful trial manufacture of D-grade circular ring chain. Newly-developed low-alloy light rails can more than double the useful life of light rails used in mining. The performance of Grade III steel bars manufactured in China in the past could not meet advanced standard requirements, but the performance of the newly-developed Grade III low-alloy steel bars with a strength of 380 N has attained advanced international standard levels and we now have the capacity to produce them in large amounts. Manufacturing trials of high-strength low-alloy precision rolled threaded steel bars and the associated connectors and ground tackle have been successful. Substitution of these steel bars for existing cold-drawn steel bars can result in a 20 to 40 percent savings on steel products. Pre-stressed 70SiCr low-alloy steel wire has a stress relaxation rate of less than 4 percent, which is a rather substantial reduction compared to R 80 common pre-stressed carbon steel wire. The production techniques of this type of steel wire are simple and require no stabilized processing. In the area of low-alloy steel used for ships, complete blanks were filled in the areas of A (0°C), D (-20°C) and E (-40°C) for 320 N and 360 N, which made it possible for all shipping steel of different grades with a thickness of 10 to 50 mm to be produced in China, and quality has reached Chinese Ship Inspection Bureau ZC specifications and international IASS standards. Manufacturing trials of Z-cross section steel resistant to laminar tearing with a contraction rate of less than 35 percent were successful, and quality reached Japan's KD36-Z35 standards. During the Sixth 5-year Plan, X60 and X65 pipeline steel was used to produce a 2,000-plus ton secondary oil transmission pipeline that was added between Anshan and Dalian, and quality met United States API standards. In addition, gratifying progress was made in high-strength steel used in engineering machinery welding, low-sensitivity CF steel used for welding cracks, biphase steel used in vehicles, low-alloy wear-resistant steel, low temperature steel and other areas.

There were rather substantial changes in production technologies in the following areas during the Sixth 5-Year Plan:

1. The proportion of low-alloy steel from oxygen conversion furnaces exceeded that of conventional furnaces and many medium and small-scale

enterprises now can produce excellent quality low-alloy steel. Their output now accounts for nearly one-fourth.

2. The number of pieces of steel wrap blown powder equipment increased from 8 to 25 and spray desulphurization technologies have been adopted in large numbers. The average useful life of inflammable high-aluminum graphite spray guns developed in China reached 19 times per gun. Silicon-calcium powder agent [production] has been established in China, which has eliminated the need for further imports from abroad. Besides the spraying of silicon-calcium powder, the results of experimental spraying of synthetic slag and rare earth alloy powder also were quite good.

3. New advances have been made in the use of micro-amounts of titanium and rare earths to process steel. The addition of  $< 0.02$  percent of titanium to steel to improve the toughness and weldability of carbon steel has been adopted in many factories and the amount of low-alloy steel processed with rare earths exceeded 100,000 tons in 1985.

4. Output of microalloy steel containing titanium reached 180,000 tons in 1985. Low-carbon titanium steels like 06Ti, 10Ti, 13MnTi, 15Ti and others are being used in large amounts in stamping vehicle parts and enamel baseplates as well as steel bars, bicycles and many other things.

5. Controlled rolling and controlled cooling technologies also have come into use. The development of the M-type controlled rolling method in conjunction with the special characteristics of China's rolling mills has led to a vast expansion in the use of water-bath quick-cooling for steel bars after rolling.

Many new achievements also were made in the area of applied and theoretical research. Examples include a full-buoyancy model explaining molten bath flow phenomena within blown steel wrappings that conforms more closely with reality than current international models. The use of mathematical methods to model flow phenomena in molten blow baths has provided the conditions for using reaction engineering to study the refining metallurgy process of steel wrappings. Research on the behavior of medium and large particle inclusion metallurgy in blown powder processing led to the discovery that rolled slag is a major source of large particle inclusion. Some plants have encountered problems with increased nitrogen in blown powder steel processing and have used water modelling experiments and analysis of regularities in on-site nitrogen absorption and the rate of surface nitrogen absorption in liquid steel to find geometric formulas that describe the exposed surface area of particles, mathematical expressions for the rate of surface nitrogen absorption in liquid steel and regularities in the conditions of oxygen absorption, all of which provide a scientific foundation for controlling the nitrogen absorption process. Because of the relatively low rolling force of Chinese rolling mills, the use of multi-channel light-pressure steel rolling and research on the temperature intervals of accumulated strain effects and increasing the range of resistance to deformation has provided a foundation for the technical design of controlled rolling in old rolling mills. In the area of problems

with crystal particle mixing in controlled rolling of steel that contains niobium, a question of widespread concern, a relative deviation method has been provided to describe non-uniformity of crystal particle sizes in iron bodies, which permits additional quantitative calculations using the area of crystal particles and which has led to the discovery of measures for preventing the occurrence of crystal mixing. The mechanical properties of the large amount of 16Mn low-alloy steel produced in China were greatly improved following  $\gamma + \alpha$  biphasic region controlled rolling. Besides the refining of  $\alpha$  crystal particles, analysis and estimation of the effects of its improved mechanisms on dislocation and substructures were carried out. The relationship between the temperature intervals of controlled laminar tearing and deformation processes also was studied. Analysis and estimation of the strengthening effects of various elements on Nb-V microalloy steel after it has undergone biphasic region controlled rolling were carried out, and a new expression for yield strength and measured values that conform more closely with reality were proposed. In order to achieve total extraction and complete collection of crystal particles less than 100 Å in size, a new method was developed for nonaqueous electrolytic liquid, constant-current erosion-extraction. The equipment used for this method is simple and can assure the original shape of the material separated out. Analytical precision reached 5 to 6 percent. This method was employed to analyze new technologies and to study the fine structure and regularities in separation out in the Nb-V microalloy steel separation out phase. In addition, this created the conditions for quantitative estimation of strengthening effects and led to the proposal of a new view regarding hard-phase softening and soft-phase hardening during research on martensitic dual-phase steel in iron bodies. Moreover, it raised dual-phase steel deformation and fracturing to the level of direct dynamic observation and analysis. To prevent dangerous destruction of large structures and pressure vessels, measurement of the fracture initiation and prevention capabilities of materials was necessary. Besides the already-understood static fracture performance experimental methods, an understanding also was gained of methods and techniques for testing various dynamic fracturing behaviors. Moreover, comprehensive measurements of some basic data on welding common low-alloy steel in China as well as handbook compilation have provided a basis for formulating welding techniques. In addition, experiments on the marine atmosphere and actual corrosion from partial and complete immersion in the sea were carried out for 16 types of Chinese-made steel. Some superior varieties of steel were proposed based on analytical comparisons, and long-term basic data on the corrosion situation for domestically-produced steel was accumulated.

Based on the demand for low-alloy steel in the state's Seventh 5-Year Plan and each industrial sector, it has been predicted that yearly output of single low-alloy steel in 1990 will grow to nine million tons, up by 50 percent over 1985 and equal to about 15 percent of total steel output. There will be only a few changes in product structures. Low-alloy steel bars will account for about 42 percent, low-alloy high-strength structural steel for about 30 percent, low-alloy wear-resistant heavy rail steel for about 17 percent, low-alloy light rail steel for about 3.3 percent, atmospheric corrosion-resistant steel for about 2.2 percent and low-alloy



mining steel for about 5.5 percent. It is obvious from these proportions that there will be rather substantial increases in atmospheric corrosion-resistant steel and low-alloy mining steel. Oxygen conversion furnace composite blown steel-added wrapping spray powder processing will become the main technology for smelting superior-quality low-alloy steel. Continuous casting will increase substantially in proportion. Transformation of old rolling mills and the operationalization of new rolling mills will bring modernized controlled rolling and controlled cooling technologies into normal production. There will be new developments in controlled rolling technologies adapted to old rolling mills. Besides the utilization of large amounts of steel bars and wire, quick-cooling after rolling technologies will be extended into plate and belt production.

The primary sphere of low-alloy steel utilization will be for steel bars used in construction and high-strength steel wire. Besides the extension and utilization of large amounts of newly-developed Grade III steel bars, the focus will be placed on the development of 7.0 [mm9] diameter 1,500 to 1,600 N/mm<sup>2</sup> strength high-strength steel wire and 800 to 1,200 N/mm<sup>2</sup> medium-strength steel wire. This will raise the steel wire used in China's pre-stressed concrete to a new level. The main activities in the area of high-strength steel used for welding in engineering machinery, pressure vessels, bridges, ships, oil transmission pipelines, marine structures and other things will be quality improvement, filling in gaps and the formation of systems to create the capacity for production of large amounts of low-sensitivity CF steel used for welding cracks and "Z" steel that is resistant to laminar tearing.

Although the focus regarding heavy rails used on railroads will be placed on full-length hot processing and weight enhancement of carbon steel, attention also will be given to research and development of microalloy wear-resistant heavy rails.

In the area of atmospheric corrosion-resistant low-alloy steel, besides meeting the requirements of railroad passenger car manufacture, the focus will be placed on the development of new products with excellent weldability and formability to facilitate their extension into bridges, storehouses, vehicles and other uses.

The vehicle industry will make great efforts to develop easy-to-cut microalloy steel and microalloy forging using anharmonic steel, high-tenacity anharmonic steel and dual-phase steel used for hot-rolled punching.

In the area of low-temperature steel, the focus will be placed on dealing with 1.5Ni, 3.5Ni, 5.5Ni and 9Ni steel used at temperatures from -101° to -196°C. In addition, there also will be a need to develop some corrosion-resistant low-alloy steels and seawater corrosion-resistant low-alloy steels.

In research and technology related to steel varieties, it is predicted that new varieties will be extended like low-carbon tungsten steel, compound microalloy steel containing trace amounts of titanium, dual-phase steel for non-punching uses, titanium bainite dual-phase steel, microalloy

anharmonic steel and others. In the areas of water pre-processing of iron, top and bottom compound blow and spray alloying, continuous forging of microalloy steel, semi-finished product alloying and heat rolling lubrication to reduce rolling force to facilitate the adoption of low-temperature rolling and other things will be integrated with the characteristics of Chinese raw materials and equipment to develop the appropriate technologies and create the conditions for the production of high-quality low-alloy steel in old mills.

China has abundant alloy resources and there is a vast market for their utilization in China. The large number of scientific and technical personnel trained during attacks on key problems in the Sixth 5-Year Plan and an additional 5 years of effort surely will cause China's low-alloy steel to leap up to an even higher level.

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## NATIONAL DEVELOPMENTS

### BRIEFS

JOINT SUPERCONDUCTIVITY SEMINAR--In order to maintain China's momentum in superconductive technology and theoretical research, Beijing University's Physics Department and the CAS Institute of Physics recently decided to jointly conduct a "Superconductivity Physics and Technology Seminar." The seminar will last for one year, and will be aimed at science and engineering graduate students enrolled at universities throughout China. The chief topics studied will include classical physics theory, quantum theory, modern optics, physics of modern materials, superconductivity micro theory, superconductor technology and its application, the application of new technologies in superconducting research, etc. Upon completion of the seminar, Beijing University will award the students a certificate documenting completion. Those students who show outstanding performance can be designated a "resident candidate for the Master's degree." Enrollment in the seminar will start within a few days at the Science and Technology Section of Beijing University's Physics Department. [By Sun Shuxing [1327 2885 5281] [Text] [Beijing KEJI RIBAO in Chinese 15 Apr 87 p 1] 12625/7358

SHENYANG SUPERCONDUCTIVITY RESEARCH--The CAS Shenyang Metals Institute recently conducted comparisons of a variety of materials of differing composition in yttrium-barium-copper-oxide (YBaCuO) research, and generally achieved a zero-resistance superconductor at more than 90 degrees Kelvin. The institute has successfully prepared a variety of types of superconducting materials in bar and loop forms using YBaCuO which are stable superconductors, achieving a 100 percent success rate. These are now in small batch production. [By Fan Guilan [5400 2710 5695] [Text] [Beijing KEJI RIBAO in Chinese 15 Apr 87 p 1] 12625/7358

SUPERCONDUCTING MATERIALS DEVELOPMENT--On 8 April, the Central China Institute of Engineering and Science achieved two new results in the area of superconductor research. They have developed a superconductor which achieves a critical current density as large as 110 amps per square centimeter; and, they have discovered a new technique for recovering superconductive properties which can be lost in superconductors. The Central China Institute of Engineering and Science is conducting research using superconductive ceramic materials which begin to change at temperatures of 95 degrees Kelvin, and zero resistance at 85 degrees Kelvin. After the critical current density of 110 amps per square centimeter has been in a superconducting state for some time, it will suddenly

go to a larger current with a critical current density of 600 amps per square centimeter. The phenomenon of losing superconductivity has not been observed. [By Wang Qinwen [3076 0530 4489] [Text] [Beijing KEJI RIBAO in Chinese 15 Apr 87 p 1] 12625/7358

PROTECTING ENVIRONMENT IN DEVELOPING ECONOMY--Beijing, 22 Jun (XINHUA)--China has set up environmental monitoring systems at the national provincial and city levels to protect the environment while developing the national economy. It has also built 1,277 monitoring posts at the county level, reported today's ECONOMIC DAILY. According to the newspaper, the country has more than 7,000 scientists and technicians engaged in the work. They achieved 154 research findings during the sixth five-year plan period (1981-1986). The country has worked out laws and drawn up a systematic and detailed plan for environmental protection work for the seventh five-year plan period (1986-1990), the paper said. While boosting the economy, large cities have recorded a general improvement in the environment owing to the policy of simultaneous construction of the economy, urban construction and environmental construction, the paper said. The country has finished the construction of 167 large key projects in the field in the last few years, and local governments have halted 4,251 high-pollution projects and shut down or removed 216 high-pollution enterprises, the paper added. [Text] [Beijing XINHUA in English 0804 GMT 22 Jun 87 OW] /9738

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REDUCTION OF OXYGEN ON LEAD ELECTRODE IN AQUEOUS SOLUTION OF  $H_2SO_4$  AT LOW TEMPERATURES

Hefei ZHONGGUO KEXUE JISHU DAXUE XUEBAO [JOURNAL OF CHINA UNIVERSITY OF SCIENCE AND TECHNOLOGY] in Chinese Vol 17 No 1, Mar 87 pp 33-38

[English abstract of article by Hang Hu [2635 3840] of the Department of Modern Chemistry]

[Text] The rotating disc electrode made of lead was used to investigate the reduction of  $O_2$  on a lead electrode in  $H_2SO_4$  solution at different temperatures. It was found that this reaction at  $-20^\circ C$  is not a four electron reaction as at room temperature, but is basically a two electron reaction. (Paper received 15 Nov 85.)

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STUDY OF KINETICS OF RADICAL POLYMERIZATION OF TRIBUTYLTIN METHACRYLATE IN SOLUTION

Hefei ZHONGGUO KEXUE JISHU DAXUE XUEBAO [JOURNAL OF CHINA UNIVERSITY OF SCIENCE AND TECHNOLOGY] in Chinese Vol 17 No 1, Mar 87 pp 51-58

[English abstract of article by Han Zhewen [7281 0772 2429], et al., of the Department of Applied Chemistry]

[Text] The kinetics of polymerization of tributyltin methacrylate (TBTM) are studied in benzene solution at the temperature range of 50-75°C in the presence of azobisisobutyronitrile (AIBN). The authors have obtained the rate equation as follows:  $R_p = K_p[TBTM]^{1.5} \cdot [AIBN]^{0.5}$ . The activation energy for polymerization has been determined to be 18.1 kcal/mol. The activation energy for the degree of polymerization is approximately -12.3 kcal/mol. (Paper received 8 Jul 85.)

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THIN AND MODERATELY THICK PLATE ELEMENT SATISFYING IE TEST AND ITS APPLICATION TO DYNAMIC EIGENVALUE PROBLEMS

Hefei ZHONGGUO KEXUE JISHU DAXUE XUEBAO [JOURNAL OF CHINA UNIVERSITY OF SCIENCE AND TECHNOLOGY] in Chinese Vol 17 No 1, Mar 87 pp 69-76

[English abstract of article by Wang Xiuxi [3769 4423 0823], et al., of the Department of Modern Mechanics]

[Text] In this paper a quadrilateral plate bending element which involves shear deformation is presented, satisfying the "individual element test" with the form of "free formulation." Shear deformations are directly proportional to the square of the plate thickness, and the results of the thin plate theory are approached automatically as the plate thickness decreases. Dynamic eigenvalue problems of plates are analyzed with the element, and excellent numerical results are obtained. (Paper received 30 May 86.)

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